Critical Reasoning 03 – Cogency and Analogy

In the last critical reasoning unit we examined validity as a property of deductive arguments where, if all the premises are true, then they guarantee the truth of the conclusion(s). Outside of the relatively tame confines of Mathematics and Formal Logic however few arguments conform to the simplicity and rigor of such basic valid arguments as *modus ponens, modus tollens* the disjunctive syllogism or any of the other named forms mentioned. Instead most real world arguments rely on **inductive reasoning** to arrive tentatively at their conclusions. Consider the following inductive argument:

Stepping Stones

1. The Sun has risen on every day in human history.
2. ∴ The Sun will rise tomorrow.

This argument is very strong and any reasonable person would be persuaded by it, even though the premise dose not *absolutely* guarantee that the conclusion will necessarily be true. It could be for example that one day in the future, a nearby star will go Super Nova and obliterate our solar system, in which case there will be no more sunrises. The odds of that happening though are so vanishingly small that for practical purposes we simply ignore the possibility, but not for logical purposes. If there is any possible world in which the premise(s) could be true and the conclusion simultaneously false, then the argument in question is not valid. So how can an argument such as this one that is not even valid be so persuasive? The answer lies in the expanded structure of the premise and its relation to the conclusion. We could rewrite the argument above as follows:

1.1 Today the Sun has risen.
1.2 Yesterday the Sun rose.
1.3 The day before yesterday the Sun rose.
1.4 The day before the day before yesterday the Sun rose.
…
1.n Day n ago in human history the Sun rose.
2. ∴ The Sun will rise tomorrow.

While each line of the expanded premise makes the probability that the sun will rise the following day slightly probable, the cumulative weight of over 3 million such days of observation, over some 10 000 years of human history, makes it a near certainty (but not a logical necessity).

Inductive arguments such as this one that are well structured such the truth of the premises makes the truth of the conclusion highly probable are known as **strong**. Most such arguments tend to rely on some aspect of the universe remaining the same or being predictable. However, consider the following inductive argument:

1.1 Elvis was seen filling his up his Cadillac at Waxman's filling station in Sanderson County, Georgia two days after his reported death.

1.2 Elvis is spotted in a McDonald's in Florida in July 1985, eating dinner with a mysterious woman and a bag of cash.

1.3 A Bearded Elvis is spotted by Steven Patrick in a Swiss late-night cafe at 2am in the summer of 1986. He slipped away after claiming to be from Vegas.

1.4 Elvis is spotted by Paul Doe in Berlin, German, in July 1991 talking to the driver of a horse-drawn carriage. Doe and pals decided not to approach him out of respect and instead went for a few pints of beer.

…

1.n Elvis was seen by Jason R in Stanley Park, Vancouver, Canada in July 2001. Elvis sped past on roller blades and stole a bucket of KFC.

…

_____

2. ∴ Elvis walks among us.

Because each premise above *does* make the conclusion probable and each additional sighting *would* make it even more probable, this argument is strong like the first one. Unfortunately all these premises are demonstrably false (*pace* what Elvis millenarianists believe – believing doesn't make it so.) Therefore strong arguments, where in addition, the premises are known to be true are called **cogent** whereas those such as the Elvis argument above, where in addition, the premises are false are not cogent. Cogency among inductive arguments therefore is analogous to soundness among deductive arguments but the terms cannot be used interchangeably because they pick out different categories.

Finally an inductive argument such the truth of the premises makes the truth of the conclusion(s) only slightly probable are known as **weak**. Consider the following inductive argument frequently touted by technophobes.

1.1 Person 1 developed brain cancer after using a cell phone for a number of years.

1.2 Person 2 developed brain cancer after using a cell phone for a number of years.

1.3 Person 3 developed brain cancer after using a cell phone for a number of years.

…

1.n Person n developed brain cancer after using a cell phone for a number of years.

2. ∴ Cell phone usage causes cancer.

The fact that n people developed cancer of the brain is tragic but just because most of them used cell phones for a number of years does not prove that cell phones actually caused their cancer. What has not been included in the premises is that cell phone safety has been under investigation for more than two decades and nothing adverse has ever been demonstrated. Also not taken into account here is that, even in developing nations, almost everyone is a cell phone user. Therefore to separate out two groups into cell phone users and non-cell phone uses is practically impossible. For that you would require a controlled experiment in which an experimental group is exposed to cell phone radiation over many years while a control group is not, after which the results would have to be compared and analysed. See Critical Reasoning 12 – The Scientific Method

Mistaking correlation for causation is just one source of weakness among inductive arguments. Critical reasoning unit 4 is devoted to all manner of faulty reasoning. For now we turn to another form of inference namely: **analogy**. While valid deductive arguments argue from one or more general premises to a logically certain conclusion(s) and cogent inductive arguments argue the other way around from specific incidents to general conclusions, analogies offers a third way by allowing the transfer of information or meaning from one particular (the source) to another particular (the target) both of which are similar in important respects.

Suppose that a baker is trying to explain to you some of the fundamentals of her art. She tells you that just as you would put bicarbonate of soda in your crunchies to make them rise, so you would add yeast to your dough to make it rise. She is using the analogy, bicarbonate of soda is to crunchies what yeast is to dough or,

> bicarbonate of soda : crunchies :: yeast : bread,

where the colons stand for "… is to ..." and the double colon stands for "… as …" The analogy succeeds because the source and the target are sufficiently similar with respect to the relation that obtains between them, namely the rising of baked goods. Moreover, the mechanism of rising by the release of carbon dioxide when heated is the same in both cases, but that is where the analogy ends. Bicarbonate of soda ($NaHCO_3$) is a mineral salt whereas yeast is a collection of living organisms (fungi of the species *Saccharomyces cerevisiae.*) They literally could not be more different than chalk and cheese, which is itself another analogy.

The case of similar triangles in geometry can be used to convey information such as the size of one or more angles from one triangle to the other, if either they have been given as or proved to be similar. Interestingly, mathematicians have a method that allows these sorts of relations to be derived via deductive arguments, but we will not examine them here. For now we can represent the relation between similar triangles ABC and DEF and one or more of their respective features such as angles B and E as,

∠B : ΔABC :: ∠E : ΔDEF
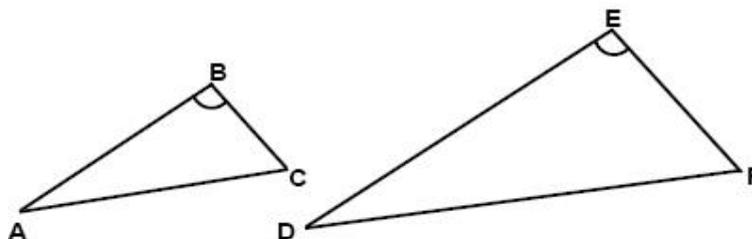
If we have information about one of the similar triangles we can use this to calculate information about the other using basic trigonometry. The object here is not to dwell on the laws of sines and cosines but to appreciate that in similar cases, information can be transferred in a formal manner with great precision from one source to an appropriately similar target.

Another kind of analogy underlies a highly emotive, highly lucrative, multi-billion dollar industry, largely opaque to public scrutiny: that of animal drug trials. We merely observe the analogy here as another instance of the transference of information between particulars, setting aside for now all merits and ethical detractions. The analogy is that a drug d at dose x is to a non-human animal species S what drug d is at relative dose y is to humans, which may be represented as:

$$x \text{ mg of } d : \text{species } S :: y \text{ mg of } d : \textit{H. sapiens}$$

The key assumption is that species S' physiology is sufficiently close to that of humans so that what is manifestly effective, toxic or otherwise at a given dosage in the animal model will be predictive of same drug at a relative dose in the human target population.

Finally, the modern field of **game theory** which is the study of models of strategic decision making by rational agents under conditions of conflict and cooperation, itself rests on analogous reasoning. In Classic Text 10 we will be investigating the game of "Prisoner's Dilemma" to garner what self-interested benefit there might be in acting altruistically, especially to people we don't even know.

Task

Gather again about ten different arguments. Decide which of them are deductive, inductive analogous or otherwise. Now try to analyse them further. If some are deductive, which of them are valid or invalid and why? For those that are valid, which of them are sound, if any? Similarly with those that are inductive: which of them are cogent and if so, why, and of those that are, which are weak and which are strong? Similarly with those that invoke an analogy: are the target and the source really similar in appropriate ways such that information can be inferred from one particular to the other? What about arguments that don't fit neatly into either category, or that seem obviously flawed; how would you characterise them? If you do not want to use your own arguments you could analyse the following:

1. Benjamin Franklin was the first Post Master General of the United States. He was also the inventor of bifocal lenses. So the first Post Master General of the United States was the inventor of bifocals.

2. Engineers have built a scale model, forty to one, of a proposed structure and tested it in a wind tunnel at hurricane category five velocity winds as well as on a shake table at a Richter scale equivalent of an approximate magnitude 10 seismic event. Therefore, barring catastrophic failure, the structure will endure.

3. All Ferraris are red except when they are black or yellow. All tomatoes are red when they are not green. Therefore if something is red then it is either a Ferrari or a tomato.

4. The exasperated mother's argument: "If I have told you once, I have told you twice, and if I have told you twice, I have told you a million times, and since I'm telling you now, I've already told you a million times!"

5. The exasperated mother's second argument: "Nic, I have said no! ..." "... Don't tell me that Johnny is allowed to do it. If Johnny jumped into a fire would you?"

6. The jerk's argument: "She smiled at me. So I know she wants me!"

7. Almost all Hindus are vegetarian. So the new neighbours, who are Hindu, will be vegetarian.

8. Clinical drug trials among thousands of fruit fly larvae and African clawed frog adults have revealed no adverse effects of *Zombinol*® whatsoever. Therefore we should bring forward the date for clinical trials in humans to get this drug on the market.

9. Either I remain in this dead end relationship forever or I will have to move on, and since I *don't* intend remain this way forever, I *am* going to have to move on!

10. All known life forms depend on liquid water to exist. Therefore only planets on which liquid water exists potentially harbour life.

Feedback

There is a false and misleading impression about Philosophy, created by those who know nothing of the subject, that everything is relative, nothing is wrong or wright, that anything philosophical goes. Nothing could be further from the truth. Philosophy, and especially Analytic Philosophy as espoused via this website, aspires to be truthful and correct or at least not demonstrably false. Accordingly, every one of these arguments has only one right categorization, although each may be approached in several ways. Use the information you have read through as well as your own judgement to assess the answers you have worked out. You are probably better at this task than you know because you have been dealing with arguments ever since you learned to speak or to sign, although you may not have been aware of it. Compare your analyses to those below.

1. This is a valid argument because if the premises are true they absolutely guarantee that the conclusion must be too. This argument is also sound because it is an historical fact that Benjamin Franklin was the first Postmaster General of the United States as well as the inventor of bifocals.

2. This argument relies on an analogy between a scale model and the actual structure to be built. In terms of safety, the scale model is able to endure simulated conditions of the most severe hurricanes and earthquakes therefore it can be expected that the full scale proposed structure will similarly endure. "Barring catastrophic failure…" is known as an **escape clause** because it allows the conclusion to escape being false, even or especially in the case of something unforeseen. The analogy here is highly appropriate because the scale model is specifically designed by engineers to resemble the proposed structure in important respects, especially safety.

3. This argument is an invalid deductive argument. It makes the mistake of affirming the consequent of a conditional statement, so it is a fallacy. Even if you had never learned anything about arguments formally, this one should have made you suspicious.

4. The exasperated mother's argument is a valid deductive argument because if the premises are true then there is no way that the conclusion could be false. Fortunately, this argument is also unsound because there is no way that telling someone once means telling them twice and so on up to a million times. Sometimes you can just tell someone once, but it is easy to sympathise with parents that are prone to hyperbole, especially when they are not being heeded.

5. The second exasperated mother's argument is one from analogy. Johnny and his permitted activity are the source, while Nic and his prohibited activity are the target. It is impossible to agree on just how appropriate the analogy is without knowing just what Nic is not allowed to do. If it were something rash or dangerous then there is a high degree of similarity in respect of the activities and the analogy would be appropriate. If it were trivial by comparison then the exasperated mother would probably be hyperbolising.

6. The jerk's argument is neither deductive nor analogous, nor is it inductive because it is arguing from a single instance, nor is it any of the other standard forms of argument that we are yet to learn. There are as many reasons to smile as there are reasons to be happy, and then some. One could also smile politely, nervously or even sarcastically, none of which would portend lust. So the conclusion simply does not follow by any means.

7. This is a very strong, cogent inductive argument, since the premises make the conclusion highly probable. If only a few or even just over half of Hindus were vegetarian the conclusion would have been much less likely to be true and the argument would have been so much the weaker.

8. This argument for the acceleration of drugs trials to humans is based on an appeal to an insufficiently similar analogy. Although fruit flies are a standard animal models in genetics, the adults, not the larvae are studied for the expression of certain genetic markers. Both fruit flies and African clawed frogs, (another standard experimental species) are insufficiently physiologically close to humans to be significantly analogous. For just one example, neither is even warm blooded as mammals are. Therefore the case for moving the existing trials forward to human clinical trials is weak.

9. This is a valid deductive argument of the disjunctive syllogism form. If we take the veracity of the premises at face value then then the argument is also sound and, so long as there are no other alternatives, then arguer will surely have to decide to move on.

10. Finally, this is a cogent inductive argument of unknown strength. We do know that the single premise is true for all terrestrial life forms that we have discovered. But, since we have not had a chance to examine any extra-terrestrial species, we do not know for sure that we can make such a universal generalization. It used to be, for example, that before Europeans discovered Australia, they unquestionably believed that all swans were white… until black swans were reported down under. Similarly, at present, our life scientists unquestioningly assume that, all known life forms depend on liquid water to exist. Until we know more about extra-terrestrial biology, of which presently we know nothing, we remain in the realm of conjecture.

The next Critical Reasoning study unit concerns fallacies.