Causality's Black Box

Mathematics and logical necessity in al-Ghazali's Incoherence of the Philosophers

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Abstract

This paper seeks to examine Al-Ghazali's notoriously controversial views on causality from the perspective of the mathematical sciences, specifically mathematics and astronomy. I will show that Ghazali's arguments against necessary causation depend on looking at nature as though through a black box: he is claiming that philosophers don't understand causation because we can logically imagine an alternative. In several points in his discussion, however, he uses astronomical examples as examples of clear, necessary causal events as reasons why theologians should not question those results. Rather than being an occasionalist, Ghazali appears simply to be expressing the kind of scientific skepticism necessary for the advancement of any science, and calling philosophers to task for their arrogance in thinking they had the world all figured out. His use of theological examples is, fundamentally, beside the point: a necessary concession to his audience.

Introduction

Al-Ghazali, philosopher and theologian, very much lived in two worlds. Philosophy in the medieval period represented the culmination of logic and rationalism, and religion was born on the strength of revelation, and in many quarters, a letting go of reason. To straddle these worlds is not easy today, nor was it in the late 11th and early 12th centuries CE when Al-Ghazali was writing. To what degree was Al-Ghazali beholden to religious tradition, and to what extent had he sold his soul, so to speak, to the power of logic? The implications of this question are never clearer than when

Ghazali addresses issues of causality. Is Al-Ghazali an occasionalist like the Ash'arite school to which he nominally belonged, or was he a determinist, or perhaps a radical skeptic? While it is dangerous to try to tease out what he believed from a polemical work like *The Incoherence of the Philosophers* in which he so often seems to be merely playing devil's advocate, perhaps, nonetheless it is possible to say what he *isn't*. At the very least, I hope to clarify some questions that need to be posed of his other texts on the nature of causality in his thinking. To what extent does causation play a role in his view of natural philosophy, what today we would call science, and how does mathematics come to bear on this question?

When Avicenna (Ibn Sina), to whom Ghazali is mostly responding, divides the sciences, he does so into three categories: the natural sciences, the mathematical sciences, and the science of metaphysics. Al-Ghazali maintained the same divisions in the sciences as Avicenna. It may surprise modern readers precisely what was included in the various categories, for instance, physics was a natural science, but astronomy was not. Astronomy was included in the mathematical sciences, along with geometry (McGinnis, 2010).[1] Astronomy was the first of the sciences to be fully mathematized in the 2nd century CE by Claudius Ptolemy. It would not be until the 17th century CE that physics would begin to be so. At the time of Al-Ghazali, physics was no more mathematical than biology or botany, and indeed, was perhaps closer to metaphysics than would make most modern physicists comfortable. It will be this contrast between physics and astronomy that we will wish to tease out, for it will be precisely the contrast

[1] It should be noted that astronomy and astrology had already been peeled off from one another by this point, in order to save the solid astronomical predictions from the more theologically controversial astrological ones (Ragep & al-Qushji, 2001).

between the burning of cotton (physics) and the prediction of eclipses (astronomy) that will be at issue.

Before considering the specific examples, though, I want to define what I mean by “black box”. A *black box* in this context hides what is going on from observers. One can see what is happening on the outside, i.e input and output, but one does not know how the mechanism works on the inside. In our model, this is analogous to Ghazali’s causal relations. We can see the cause, we can see the effect, but we do not know the mechanisms that make them work the way they do. In particular, consider his example in Section 9 of Discussion 17 of the sunlight that sometimes makes objects bleach, and sometimes makes them darken (Incoherence 17:9). This is precisely the kind of black box that is used in modern scientific experiments; the human mind is sometimes described as the ultimate black box.

I

Before we look at specific examples from *The Incoherence*, it’s necessary to talk a little bit about the way mathematics works. In geometry, since this was the mathematics available to Al-Ghazali, one begins with a premise, or axiom, that is apparently incontrovertible. Let’s say, two parallel lines never intersect. To these basic axioms, one adds definitions, such as a parallelogram is a 4-sided figure whose opposite sides are formed by sets of parallel lines. From there, a geometer takes the axioms and the definitions together with whatever else one has proved before from these same

Figure 1. Parallelogram.

basic elements, to prove other things, like the opposite angles of a parallelogram must also be equal to each other, just as the opposite sides must also have equal length. If one takes these basic axioms and definitions as given, it is mathematically and logically *necessary* that a parallelogram must have these features, and it is impossible to imagine it otherwise. To suppose that one could imagine it otherwise is not to understand the premises and definitions that went into the proof.

Mathematics is admittedly an abstraction from reality—indeed, it must be to some degree to have clear definitions—however, to whatever degree it does agree with reality, the real object will have the same properties as an abstract one. To use the same example of the parallelogram, it is exceedingly difficult to draw lines that are truly parallel, so any parallelogram that we attempt to draw will never exactly fit the true definition. However, we are capable of making lines convincingly parallel over short distances, and to that extent, we can conclude that any parallelogram we draw will approximately have the same properties as the abstract one. With care, we can get them quite close, even to the point where we can't measure the deviation from the mathematical prediction at all; perfection, no, but close enough. It was this notion of abstraction that Plato employed when developing his theory of the forms. However, defining forms about more complicated objects in the real world, like fire, proved rather more difficult.

The idea of mathematizing science begins with astronomy. Astronomical objects have relatively simple motions compared to the complicated things we have on Earth, and so astronomers attempted to apply mathematics to the motions of the heavens in order to make predictions of their movement. Their metaphysical nature is set aside in

a very instrumentalist account. Astronomers, of course, wanted a model that actually corresponded to what was going on in the heavens, so while Ptolemy's model made relatively accurate predictions, his method of achieving predictive success motivated a number of astronomers, including Islamic astronomers, to postulate more physically plausible models, though none succeeded in overturning Ptolemy completely until Nicholas Copernicus (Ragep & al-Qushji, 2001). But because the geometry was so well established, one needed to add only a few additional premises relative to the astronomical objects themselves, regarding their motion rather than their substance. As long as these premises could be thought to be held, then their motion must surely follow from the power of geometry.

Al-Ghazali uses the example of an eclipse (*Incoherence*, 2nd introduction: 15), but I want to use a simpler example to illustrate the point: the sunrise. In order for the sun to be visible, the line of sight between the Sun and a person standing on the Earth must be unobstructed; in particular, it must be unobstructed by the Earth. At any time when the line of sight to the Sun hits the Earth before the Sun, the Sun will not be visible. However, when the Sun is in a place in its orbit where the line of sight does not intersect the Earth, then the Sun will rise and be visible in the sky. The only premise one needs to

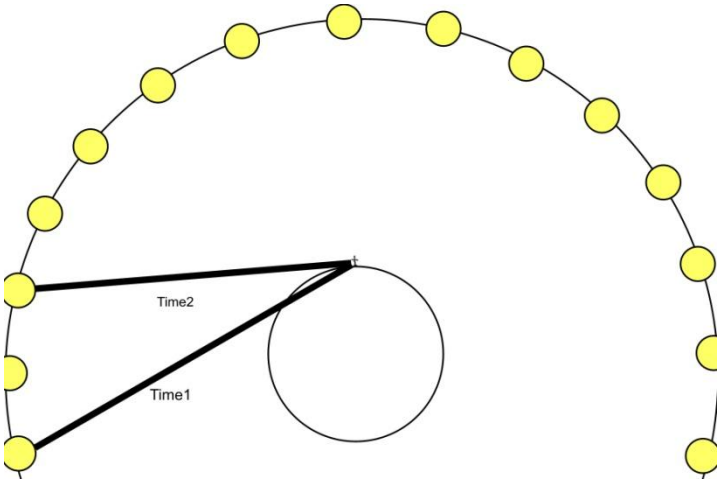

Figure 2. Geometry of the sunrise. For a person standing on the Earth, the sun is only visible when the line of sight between the person and the sun does not pass through the Earth. At Time1, the sun is not visible because the line between the person and the sun is obstructed. But at Time2, the sun is visible because there is no obstruction.

add to the geometrical foundation is that the Sun is in motion, and that the motion is regular. (Adding that it travels at a particular rate, will tell you when it will rise, but is not necessary to say that it will rise at all.) As long as the Sun exists and the Heavens turn, the Sun must rise. It is a geometrical necessity, and given the geometry, it is impossible to imagine it being otherwise: the Sun cannot rise if this configuration is not occurring. If something changes, the geometrical necessity tells astronomers that something about their premises must be false.[2]

It is precisely this kind of geometrical certainty that Al-Ghazali points to in the Second Introduction, Section 15, when he quotes astronomers, "'The lunar eclipse consists in the obliteration of the moon's light due to the interposition of the earth between it and the sun, the earth being a sphere surrounded by the sky on all sides. Thus when the moon falls in the earth's shadow, the sun's light is severed from it.'" (*Incoherence*). He goes on to say in Section 16 that it serves no purpose to dispute these things for it harms religion rather than science, for they "leave no room for doubt." (*Incoherence*)

Al-Ghazali does not appear in this passage to be doubting the causal link between the geometric configuration of the heavens and the temporal events on the Earth. Indeed, he is asserting that there is a causal connection between them, and further enjoins his fellow theologians not to challenge the logical connection because it cannot be doubted. He further goes on to say, in Section 19, that even the Koran

[2] It should be noted here that Al-Ghazali was certainly working under a view that was geocentric. This does not negate the geometry, however. Given the premise that the Earth is the center and the heaven turn, the geometry follows clearly. The fact that there is another configuration, one where the Earth turns instead, creating the same geometry only means that you can't tell from just the sun rising which premise is true. But either leads to the same conclusion about the sunrise. Science has to distinguish the two configurations with different information (parallaxes, for instance). This problem of overdetermination is one of the problems Al-Ghazali grapples with, as does modern science.

should be interpreted metaphorically rather than reject such sound science (*Incoherence*).

This is a very strong claim. We will wish to contrast this view with what Al-Ghazali says about causation in Discussion 17 for it appears that they cannot be further apart.

II

Al-Ghazali begins Discussion 17 with this statement: "The connection between what is habitually believed to be a cause and what is habitually believed to be an effect is not necessary, according to us." (*Incoherence* 17:1) He appears to be accusing natural philosophers of committing a *post hoc, ergo propter hoc* fallacy (Goodman, 1978). As the saying goes in statistics: correlation does not equal causation. To make the causal connection, one must have a mechanism by which the alleged cause can bring about the alleged effect. But more than this, Al-Ghazali is accusing the philosophers of having a black box as their causal connection, a mechanism that they really don't understand. Because violating the conditions of their alleged causes is logically imaginable, and thus possible, they cannot be said to have found the true cause.

To make matters more to the point, Ghazali goes on to say something that appears to directly contradict what he said in the introduction:

> …it is not a necessity of the existence of the one that the other should exist, and it is not a necessity of the nonexistence of the one that the other should not exist—for example, the quenching of thirst and drinking, satiety and eating, burning and contact with fire, *light and the appearance of the sun*, death and decapitation, healing and

> the drinking of a medicine, purging of the bowels and the using of a purgative, and so on to [include] all [that is] observable among connected things in medicine, *astronomy*, arts and crafts. Their connection is due to the prior decree of God, who creates them side by side, not to its being necessary in itself, incapable of separation. On the contrary, it is within [divine] power to create satiety without eating, to create death without decapitation, to continue life after decapitation, and so on to all connected things. The philosophers denied the possibility of [this] and claimed it to be impossible. (*Incoherence* 17:1) [emphasis mine]

Let's tease out the astronomy example here. In all of his examples, he is listing the cause first, and then the effect. So what is he saying about astronomy? He is rejecting the connection between the appearance of light (a cause) and the appearance of the sun (effect). Certainly, most astronomers would argue that if you see light in east, it does mean the Sun is about to rise. But that is not the necessary connection in geometry that we talked about earlier. We said that the sunrise is caused by the motion of the Sun around the Earth, and sunrise depends on our line of sight to the Sun. Once the Sun is in the sky, of course, it must be light out, but the causation doesn't go in the other direction. Al-Ghazali is essentially saying we cannot use light to predict the presence of the Sun. For anyone familiar with large bonfires, never mind electric lights, we know the connection in this direction does not work; it is not a logical necessity. The light on the horizon might have many causes: a town on fire, or the sun about to come up. Based only on the appearance of light on the horizon, one cannot predict that the sun will rise.

This does not actually contradict anything Al-Ghazali said in the Introduction. Indeed, his eclipse example is conspicuously absent.

Causation, he is saying, should be rigorously *predictive*. If A happens, then B *must* happen (Goodman, 1978). This is different than Aristotle's requirement of "always or for the most part" (Aristotle, 1984). Those things that we understand with the same rigor as mathematics cannot be doubted, but if we are peering into a black box, where the event may be statistically likely but not required, we cannot say that we have a true cause, causes being "incapable of separation."

In Section 5, Al-Ghazali discussed the burning of cotton and continues laying out the problem using the religious language that his readers would understand:

> The one who enacts the burning by creating blackness in the cotton, [causing] separation in its parts, and making it cinder or ashes is God, either through the mediation of his angels, or without mediation. As for fire, which is inanimate, it has no action. What proof is there that it is the agent? (*Incoherence* 17:5)

Like Hume, this is a skeptical challenge to the philosophers (Nadler, 1996), prove to me that that the one must logically follow from the other. Explain to me how it works. We know that the light on the horizon comes because the Sun has a certain geometric configuration (not the reverse), but how does the fire burn the cotton? Why must the connection between the fire lead to the burning of the cotton? Otherwise, it might as well be God, for all we have is the black box: input and output, and no reason to say that the one must lead to the other. If God, or the inner workings of the black box, changes, then the relationship will change, and we will be no wiser. Al-Ghazali is pushing the argument hard with the fire and cotton example, but it is so clear with his medicine example: medieval medicine being what it was, it was mostly hit and miss if a particular treatment would work or not, and saying that the effect came from the cause

at all was quite dubious. Indeed, that is the very reason why modern medicine controls for the placebo effect: the patient may just have gotten better on his own and not because of the medicine.

Of course, Al-Ghazali has ulterior motives: he wants to preserve the power of god to perform miracles, but he thinks he can do that by demanding high standards for causation that give the divine room to work. He is not rejecting the idea that no necessary connections are possible—his example of the eclipse proves that—but he thinks that philosophers are jumping to conclusions too soon. They don't really know how fire works, and just saying that they do doesn't make it so, or that the connection between fire and burning is not logically necessary, no matter how many times they see it happen.

Indeed, as this passage from Section 5 makes clear, he is not even eliminating the possibility of secondary causation for he explicitly allows for God to act with or without mediation. "His angels" are just religious language for the forms, natural laws if you will (Goodman, 1978), for even allowing angels to act as mediators is a deviation from the pure occasionalism of the Ash'arites.

The rest of Ghazali's argument is explicitly Humean in nature, and aligns with his own skeptical inclinations. In Section 15, Ghazali argues that just because we haven't seen other possibilities happen, doesn't mean they cannot (*Incoherence*, 17:15). We are left with only a statistical analysis: it's happened a lot, so we should expect that it will happen in the future similarly—"habitually"—but this does not eliminate the possibility that our predictions based only on statistics will fail. Because we do not know the reasons for the logical connection between these events, we may be proven wrong.

Furthermore, we must acknowledge that we may be wrong until we can establish that logical connection.

Even when Ghazali attempts to defend miracles, he does so by means of following natural laws as much as possible. In Section 18, he describes what might be happening when a prophet is cast into the flames and yet does not burn (*Incoherence* 17:18). All of his arguments are explicitly naturalistic, even though they are being done at God's behest, and it is causes unknown to us that interferes with what we normally predict to occur. In some sense, Ghazali is explicitly arguing for a "God of the gaps" approach, because God is working where logical necessity fails. However, he does not use the geometrical examples from astronomy, like the eclipse of the sun or moon; he does not insist that the moon can intervene between the Earth and the Sun and yet there would be no eclipse, for it is impossible to imagine.

Al-Ghazali, of course, pushes his argument as far as possible to put the philosophers on their heels. He goes on to argue about a person surviving decapitation, or the birth of children, because matters of life and death were then, and remain today, black boxes into which we cannot completely peer. This leaves enough room for god to act and work his miracles. These are fantastical examples, of course, but I think they were included to throw off the inevitable complaints from his fellow theologians that he was stripping god of power.

III

Averroes, in his *Incoherence of the Incoherence* responded directly to Al-Ghazali's claim that there was no logical necessity at work in what philosophers thought

of as causes. His aim was to defend Aristotelian causation against Ghazali's skeptical claims. However, like many who came after, Averroes saw Ghazali as an occasionalist, with god intervening at every moment in time, like his Ash'arite compatriots. He accuses Ghazali of sophistry (Averroes 519). Indeed, he takes Ghazali to be denying causation of any kind, despite the introductory remarks on astronomy that Averroes would surely have agreed with. He further says that "The man who reasons like the theologians does not distinguish between what is self-evident and what is unknown." (Averroes 520) But that is not the argument Al-Ghazali is making at all. Ghazali is saying that some of the alleged causes asserted by the philosophers are *not* self-evident, but he is not saying that nothing is self-evident. Indeed, the foundations of geometry are on simple, self-evident claims like parallel lines not intersecting, that must be asserted without proof. Al-Ghazali is specifically calling out the philosophers for saying that too many things are self-evident. The nature of earth is to fall is a claim made by philosophers as though it were self-evident, but why is it self-evident? What is it about earth that makes it fall? Al-Ghazali is asking philosophers to look deeper, and Averroes and the other philosophers are saying this is deep enough.

Averroes is right to say that "…since one single action-and-passivity between two existent things occurs only through one relation out of an infinite number, and it happens often that one relation hinders another." (Averroes 521) But this is what Ghazali is asserting as well. Because we are looking at the world through a black box, without understanding how it works, we do not know which causes hinder which other causes. By asserting that one thing causes another, Averroes is asserting only statistical success, as Aristotle did. Al-Ghazali is saying that we don't really understand

until we have more than statistical success; he is attacking the notion of “always or for the most part”, and asking for a tougher standard, not because he thinks it’s impossible, but because he knows from astronomy and mathematics that it *is* possible.

Averroes sees Al-Ghazali as a radical skeptic. This is clear when he further asserts that Ghazali rejects cause and effect entirely: “…he who denies cause must deny the intellect. Logic implies the existence of cause and effect...” (Averroes 522) Again, Ghazali has high praise for logic, and all things that can be rendered logical necessities. He is not questioning the value of logic—recall from the introduction that he said logic could supersede even the Koran—only that the causes proposed by philosophers meet that standard. Averroes goes on to reassert the philosopher’s standard of causation “This nature is sometimes necessary and sometimes what happens for the most part.” (Averroes 533). They are arguing past enough other, much like Aristotle and the Greek Atomists on the topic of chance. Averroes is missing Ghazali’s point, as did most of those who came after.

Conclusion

Despite Al-Ghazali’s longstanding reputation as a pure occasionalist, modern philosophers are right to question that assumption. Rather than rejecting natural causation in its entirety, he accepts that causation is possible, but that philosophers are wrong to assert that they have logically sound reasons for thinking that they’ve solved the problem of causation.

Discussion 17, in light of his introductory statements about the mathematical sciences, is not asserting that causation does not occur, but only that causation must be teased out of nature in a logically necessary way, and astronomy is a model that natural science should follow if it hopes to survive the criticism of the theologians. This is not Al-Ghazali trying to destroy natural philosophy, but rather being the quintessential scientist. Rigorous standards must be upheld or any crazy belief can be asserted. As much as Al-Ghazali wishes to defend philosophy from the theologians, he is torn by an equally strong need to defend theology from the philosophers. By demanding higher standards of proof from the philosophers, he is hoping to save it from religious challenge, and to protect religion from the unproved claims of philosophy that attack doctrine. It is a difficult balancing act, one that many religious scientists today will recognize.

Though I have tried to argue here for a strong position on Al-Ghazali's defense of science, one cannot determine his views simply from a single polemical work. All we can be certain of is that Al-Ghazali was not a pure occasionalist. More evidence from his other works, in light of the arguments here, will be necessary to determine how robustly they stand up, or whether elsewhere, he rejects even the mathematical and logical foundations on which is his understanding of causation appears to be built.

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