Metaphysical Foundations of Natural Laws in Avicennian Philosophy

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Abstract

Avicenna has aimed to establisha harmonized philosophical system that incorporates logic, epistemology, metaphysics, natural philosophy, and other types of knowledge. Although he has not directly written anything about the metaphysical foundations of science, we believe that there are some implications in his philosophy that could be considered astruthmakers of scientific propositions. As natural law is significantly correlated to "experiment", we will first discuss the epistemological aspect of experiments in Avicennian philosophy. He believes that the observation of a repeated event could lead us to a causal relationship due to the fact that accidental events are neither permanent nor frequent. Following that, the logical approach which corresponds to this epistemology will be introduced. As Avicenna's logic does not directly consider such an approach, we are to derive it from apparently disconnected chapters and then formulate them. It will be indicated that Avicenna has been aware of the differences between propositions that merely refer to existent instances and ones that consider the nature of instances. The latter obviously could refer to both existent instances and hypothetical instances. Finally, we present some points in his metaphysics that could establisha metaphysical basis for propositions concerning natural law. In addition, we will indicate that Avicenna's system is able to justify the counterfactual conditionals that relate to laws of nature.

Keywords

natural law, experiment, accidental formula, real proposition, external proposition, natural universal.

Introduction

The philosophy of science is one of the controversial issues to which lots of effort has been dedicated by modern philosophers. Metaphysical foundations which correspond to experimental science and natural law are an inevitable part of modern analytic philosophy. On the other hand, pondering over Avicenna's vast works leads us to the fact that he has aimed to establish a harmonized philosophical system that incorporates logic, epistemology, metaphysics, natural philosophy, and other types of knowledge. Although he has not directly written anything about the metaphysical foundations of natural laws, we believe that there are some implications in his philosophy that could be considered astruthmakers of scientific propositions. Natural law is significantly correlated with "experiment" in Avicennian philosophy. Thus, we start from knowledge, especially experimental ones, in the views of Avicenna. We discuss the arguments supporting experimental knowledge and assess whether they could justify us in believing them to be plausible propositions that express the laws of nature. Then we will seek Avicenna's logical viewpoints that correspond to propositions of natural laws and show that Avicenna has differentiated between propositions that merely refer to external instances of nature and propositions that indicate nature itself. This difference could be considered a logical capability of Avicenna's system by which accidental generalizations are distinguished from universal laws. Finally, we will introduce Avicenna's metaphysical opinions concerning these epistemological and logical approachessinceAvicenna's system does not accept the gap between science (experimental knowledge) and philosophy. The world is a consistent system in which different parts relate to each other. Consequently, the knowledge corresponding to these parts must be consistent (Gohari & Ghazalifar, 2015).

Avicenna divides philosophical knowledge into theoretical and practical knowledge. Theoretical knowledge seeks conceptual (*al-taṣawurī*) and verifiable (*al-taṣdīqī*) knowledge which do not pertain to the manner of action; nonetheless, practical knowledge deals with conceptual and verifiable knowledge relating to the manner of action. Both of them lead to the perfection of the theoretical faculty of the soul. He then asserts that theoretical knowledge contains three parts: the natural, the mathematical, and the divine (Avicenna, 1997, pp. 11&12).

It should be taken into account that Islamic philosophers consider the whole of knowledge as a unit that includes different hierarchical parts, in contrast to what modern philosophy of science claims (Qorbani, 2018, p. 14). Considering theIslamic philosophy viewpoint, natural philosophy falls into a lower position than metaphysics. What we intend to pursue is natural

philosophy or physics. Although natural law could (or maybe must) be followed in medicine too, we will focus on physics since there is a single approach that rules over both physics and medicine. In other words, whatever is true about Avicenna's methodology in physics, is accepted in medicine.

The subject matter (*mawḍuʿ*) of natural philosophy is the sensible body insofar as it is subject to change. This knowledge considers the essential accidents (*al-aʿrāḍ al-dhātīah*) as belonging to the body subject to change. We will discuss essential accidents in detail.

As far as knowledge goes, known subjects are derived by thinking or without thinking (Avicenna, 2012, p. 31). The first group is what the epistemological foundationalists consider basic beliefs from which other beliefs are constructed. Human knowledge is developed by deriving unknown subjects from known subjects. He also argues that the unknown corresponds to the known. Thus, just as a thing may be known as a pure concept, such as our knowledge of the meaning of the word "triangle" it may also be known as a concept accompanied by verification, such as our knowledge that the angles of every triangle are equal to two right angles (Avicenna, 2013, pp. 57&58). He continues that verification (*al-taṣdīq*) and conception (*al-taṣawur*) are two kinds of knowledge because a thing may be unknown by way of conception or it may be unknown as a verification until another verification sheds a light on it. Therefore, both the unknown and the known are divided into two groups. An unknown concept becomes known by conception while verification reveals the unknown verification.

Verification is a proposition in which a concept is predicated ona subject. For instance, copper is conductive. "Copper" is the subject and "conductive" is the predicate. As natural law is represented by propositions in which a body is the subject and its property (or relation with another body) is the predicate, we accentuate the verification and its structure.

According to Avicennian thought, propositions, like any knowledge, are derived by thinking or without thinking. Avicenna holds that known propositions are either self-explanatory or recognized by demonstration *(al-burhān)* (Avicenna, 2012, p. 167). Therefore, demonstration is the source of justification for developing human knowledge.

Demonstration

Demonstration is an argument containing syllogistic form and accepted content. (Avicenna, 2013, p. 606) Its form is Syllogism because in syllogistic argument, the human mind moves from universal concepts to particular ones. Yet the conclusion is inevitably accepted provided that its premises prove to be accepted too.

Considering the content, only accepted premisesare allowed to be used. To Muslim philosophers–especially Avicenna–accepted content includes six groups. The propositions that must be accepted are the following:primary propositions (*al-awwalīyāt*), observational propositions (*al-mushāhīdāt*), experiential propositions (*al-muqarrabāt*), intuited propositions (*al-ḥadsīyyāt*), propositions based on unanimous accounts (*al-mutawātīrāt*), propositions containing their syllogisms (*al–fīṭrīyyāt*)" (Avicenna, 2013, p. 455). Naṣīr al-Dīn Al-Tusīin his famous book, commentary on Avicenna's *Īshārāt*, differentiates between two kinds of necessary propositions: the proposition which is necessary in itself and the proposition that is necessarily accepted. In fact, whatever is necessary in itself, is necessarily accepted (Avicenna, 2013, p. 609), whereas there could exist some propositions which are to be accepted even though they are possible in themselves. Tusī here tries to shed light on the differences between epistemological and metaphysical approaches. Epistemologically speaking, we are to accept some propositions even though they are not metaphysically necessary. For instance, I see that the paper on which the essay is written is white. Since the visual sense is one of the sources of knowledge, I should accept that the paper at which I am looking is white. However, no metaphysical necessity obliges the paper to be white. The paper could be white, red, blue, or other colors. We intend to discuss the accepted propositions and declare which of them are able to be used in propositions concerning natural law.

The first group is called "primary". Avicenna writes that the primary propositions are necessitated by the essence and instinct of a clear intellect, and no external cause contributes to its necessity. Thus, whenever the intellect conceives the terms of such propositions, it makes a verification (Avicenna, 2013, pp. 457&458). These propositions are so fundamental that everyone who correctly imagines them, admits to their correctness.

The next group is observational propositions which are based on human senses. These are those whose verification is merely acquired from the senses (Avicenna, 2013, pp. 459&460). The belief in the correspondence between the senses (or the mental world) and the external world, opposes what skeptics claim. As Avicenna is not a skeptic philosopher, he accepts the validity of sensible data.

The third group, namely experiential propositions, "are judgments that are consequent upon our repeated observations, which leave a trace by their repetition"(Avicenna, 2013, pp. 46-463). Intuited propositions (the fourth group) resemble the third ones. These are propositions in which "the principle of the judgment is a very strong intuition of the soul, with which doubt is removed and to which the mind submits" (Avicenna, 2013, p. 465). From

Avicenna's viewpoint, there are different ways to scientific knowledge. Sense perception, experiment, induction, syllogism, inspiration by God, and intuition could be considered instances of these ways (Gohari & Ghazalifar, 2015). Since scientific outcomes are generally derived from experiments, experimental and intuited propositions, we gather, could be analyzed as propositions that play an essential role in the laws of nature. Therefore, we will discuss them in detail and the other ways fall under these two groups. But let us first finish the types of certainties.

Propositions based on transmitted unanimous accounts are those with which the soul finds full tranquillity, by means of which doubt is removed due to multiple observations, even though doubt is possible" (Avicenna, 2013, pp. 466&467). The fifth group is propositions that have been observed and reported by different agents. The number and quality of reports eliminate the possibility of collusion. Consequently, their report will be acceptable. The sixth and final group is propositions containing their syllogisms:

> They are propositions in which verification is made only due to an intermediary. That intermediary is not among what escapes the mind – thus, requiring the mind to seek it. Rather, whenever the two extreme terms of the problem are present to the mind, the intermediary is also present to it. An example of this is our judgment that two is half of four (Avicenna, 2013, pp. 467&468).

It should be taken into account that Avicenna's logic sets the norms for rational thought (and there are good reasons for thinking that philosophy, including Avicenna, believed this) and yet logical notions reflect discovered realities through authentic scientific practices. As a result, the way good science, in fact, proceeds is exactly the way one should acquire knowledge. He considers logic as providing an aid to discovering the rational, causal structure inherent in the world itself (McGinnis, 2008).

Experiential propositions and intuited propositions

Anexperiment is a combination of induction and an implicit syllogism. Observation of repeated results in similar circumstances tends to prove a relation (Avicenna, 1985, p. 61). Avicenna in *Īshārāt* writes:

> Experiments may necessitate a certain judgment or it may necessitate a probable one. It is inevitable that experiment has a concealed syllogistic force, mixed with the observations... experiment is established only if the soul is assured that the thing is concordant, and to which certain conditions are added. It is then that experiment is established (Avicenna, 2013, pp. 461-463).

Similarly, intuition has the same structure (an induction plusimplicit syllogism), in addition to an explaining hypothesis that expresses the causal relation governing conjunction (Avicenna, 2013, p. 465). In fact, an experiment just asserts a causal relation between two events while an intuition determines how causal factors act. For example, you have observed many times that water boils when it is heated. So you draw a conclusion like this:

● If water is heated, it boils.

This is an experiment because you affirm a relation between heating and boiling, although it is not clear why heating the water gives rise to its boiling (suppose that you don't know anything about the relationship between molecular mobility and an increase in temperature). And as an example of intuition, suppose one speculates that the moon collects the light of the sun, so:

● Whenever the Earth is between the sun and the moon, There is a lunar eclipse.

In this case, the mechanism is known in addition to the relation. Thus, experiments and intuition, as noted, have much in common and the only difference is that experiments lacks an explaining hypothesis. Therefore, it can't disclose the mechanism of the relation. Contrary to experiment, intuition proposes a hypothesis for the mechanism. In this article, we will only consider experimentsbecause intuition has a similar situation. The notable question which manifests itself is why do we trust observations based on experiments? In other words, how can we realize the relationship between bodies and predict the event according to our experiment? We must discuss Avicenna's arguments that support the validity of the experiment.

Are experiments reliable?

Experiments, as we noted, begin by analyzing some particular instances in order to find some common property or relation and then generalize the property or relation to similar cases. Whenever one asserts that "if water is heated, it boils, " he undoubtedly has not examined all samples of water but has observed some limited cases and predicted that all similar samples of water will boil in the presence of heat. It could be asked how universal affirmation is inferred from some particular instances. Why does Avicenna draw a universal conclusion by observing some limited samples? Does Avicenna neglect the fact that there must be an adequate reason to believe in universal propositions? Considering another formula in Avicennian epistemological and logical systems could provide plausible justification for accepting experiments as necessary and universal proof. He contends that an accidental event is neither permanent nor frequent. So there must be a causal

relation connecting similar cases to the same result (Avicenna, 1985, p. 61 & 2012, p. 119). This is recognized as the "accidental formula" (*al-qāʿidah al-ittīfāqīyyah*). The argument should be formed as follows:

● Premise 1: The conjunction of A and B is permanent (or frequent).

● Premise 2: Every permanent (or frequent) conjunction has a cause.

● Conclusion 1: The conjunction of A and B has a cause (Azimi, 2014, p. 451).

we add this conclusion to another premise known as the unavoidability of the effect in presence of the cause. The second argument goes like this:

● Premise 3 (Conclusion1): The conjunction of A and B has a cause.

● Premise 4: Everything that has a cause, always exists in the presence of its cause.

● Conclusion 2: The conjunction of A and B always exists in the presence ofits cause (Azimi, 2014, p. 452).

Thus, by utilizing two syllogisms and three premises, a universal affirmation (causal relation) was inferred from particular instances. The validity of the form is obviously due to the fact that it is *barbara*. Therefore, we will only examine the content of the premises. There are three premises.

The first is premise 1, which is an empirical one. This premise holds that the conjunction of two events, namely A and B, is permanent or frequent. This claim has been founded on the observation of this conjunction. In Avicennian epistemology, sense perception is a source of knowledge (Avicenna, 2013, pp. 459-460) and doesn't need any justification. The "observation of the conjunction" falls under the second group of certainties, namely observational propositions. Therefore, it is self-explanatory and hence, accepted.

Premise 4 contends that every effect inevitably exists if and only if its cause exists. This premise is an analytic proposition because a cause is defined as something that leads to an effect, so supposing the lack of effect in the presence of the cause means that what we have already considered as a cause, is not an authentic cause. In other words, when C is the cause of D:

● D exists if and only if C exists.

Thus, if D exists, we can realize that C has existed prior to D. It should be taken into account that the priority of C over D is not a temporal but an existential one. For example, if a car moves, then its passengers also move. Although the movement of the car and the passengers happens simultaneously, we intuitively know that the movement of the car causes the movement of the passengers.

Premise 2 suggests that an accidental conjunction cannot be permanent or frequent (Avicenna, 2012, p. 119). This premise emphasizes the point that an

accident could not repeat frequently. There must be some factor assuring the result. This factor is a causal relation that generates the same results in a similar situation. But there is a great deal of permanent or frequent conjunctions that incorporate no causal relations. For instance, consider the following propositions:

- Every lump of gold is less than one mile in diameter.
- Every lump of uranium is less than one mile in diameter.

As far as the first proposition goes, there is no causal relation between "being a lump of gold" and "having a less than one mile diameter." It is just an accidental regularity, whereas the situation for a lump of uranium is completely different. If a lump of uranium exceeds its critical mass – that is much less than one mile – a nuclear explosion occurs. As a result, the property of „being less than one mile in diameter" for uranium is supported by some causal relation, in spite of what happens to gold (Lowe, 2006, p. 143). To put it in another way, the property of „being less than one mile in diameter" characterizes every lump of gold and uranium, but in a different manner. The nature of uranium accounts for this property, whereas the nature of gold does not entail such a property. It is obviously an accident that in the actual world every lump of gold is less than one mile in diameter because we can plausibly consider a lump of gold which isless than one mile in diameter. We also are able to collect different lumps of gold and stick them together in order to produce a huge lump of gold. No natural law prevents such an operation whereas collecting lumps of uranium will lead to a nuclear explosion and the spread of lumps. Thus, there are some frequent or permanent events that are not supported by a causal relation. By resorting to these examples, one may reject the universal proposition affirming that every permanent or frequent conjunction has a causal relation, so supporters of „conjunction formulas" should find answers to opponents who demand a criterion distinguishing accidental regularities from causal relations or accept the failure of the „accidental formula."

Accidental and causal relations

Avicenna has predicted such a problem and in some of his work refers to similar instances. He gives a valid example that leads to knowledge and then refers to a hypothetical example that cannot ensure certainty. The first example is a natural law about herbs. He says that "scammonia purges bile". This event (purging) has been observed many times, so "being purgative" is something connected to the nature of scammonia and in special circumstances, namely lack of preventive factors, this quality manifests itself (Avicenna, 2012, p. 119 & 1985, p. 61). Then he presents a hypothetical situation in

which all humans are black, so every existent human is black. In this case, we cannot affirm that "man is black" because "being black" is not related to the nature of man (Avicenna, 2012, p. 120). What has been observed in the second example does not involve the absolute nature of man, but, as Avicenna holds, the people who have black parents (Avicenna, 2012, p. 122). It is possible to imagine some white people while scammonia (at least in the actual world and when there is no preventive factor) could not lose its property (being purgative). Thus, observation is not able to indicate its causal relation unless it discloses the essential characteristics of entities. An experiment is supposed to lead us to something connected to the nature of things or, simply put, natural powers. But how is it possible to differentiate between frequent observations that deal with the nature of objects and those which do not? There should be a criterion for detecting causal relationships.

Avicenna puts forward a procedure that contributes to the elucidation of essential features. The procedure claims that a causal relationship should be acknowledged when Ais present in the presence of B and is not present in the absence of B (Avicenna, 2012, p. 123). Therefore, the observation of the conjunction of A and B does not provide adequate proof to believe that there is a causal relationship between them. Put differently, it is not plausible to believe that A and B have a causal relationship if, and only if, "A exists wherever B exists"however, also another proposition should be asserted. Additionally, it is necessary to hold that "A does not exist where B does not exist (or is eliminated) too." So it should be formed as a combination of two propositions:

- A exists wherever B exists and A does not exist where B does not.

Although this criterion may fail to afford pure certainty, we think that it could suitably be considered as an instance of inference to the best explanation that can conduct us to natural features. We consider this process a plausible justification because our knowledge about the essence of entities is limited and it is quite impossible to take all effective factors into account. Even if we experience the conjunction of A and B in their presence and absence, another factor (like C) could have been ignored in our experiment. It should be noted that experimentation does not constantly lead to certainty due to the fact that certainty is not achieved unless we are sure that the property originates from the nature of the entity. Scammonia may lose the property of "purging bile" in some conditions. For example, in some countries, it accompanies other properties (Avicenna, 2012, pp. 122-124). Strobino claims that Avicenna's theory of science is not required to establish the possibility of definition because, for Avicenna, the sort of knowledge encapsulated by real definitions is possible due to the fact that the world to which Avicenna's theory of science applies is a world populated by essences and governed by relations between

essences, and that those essences and their relations are accessible to the human intellect. Therefore, his epistemology owes its optimism to his metaphysics. Nor is it required to establish that, and how, the basic ingredients employed in the process of acquisition of definition become available to us. Avicenna's theory of science must alternatively provide the rules of construction and the criteria of adequacy for complex terms that serve as the ultimate foundation of scientific reasoning (Strobino, 2021, pp. 306-361). However, Avicenna clearly admits the limitations of man's knowledge. In *al-Taʿlīqāt*, he asserts that we can not recognize the essence of entities. The essence of God, the intellect, the soul, heaven, fire, air, water, and earth are not revealed to us (Avicenna, 1984, p. 34). We are only able to observe a few properties of entities that manifest themselves in our perceptual system. Therefore, the Avicennian philosophical system has considered the different aspects of the human's ability of perception. However, it is plausible to believe in casual relations in permanent (or frequent) events rather than considering them as mere accidental regularities, in spite of the fact that there often is no complete certainty. We can plausibly accept that a causal relation exists between such events. If we observe that whenever water is heated, it boils, and whenever heat is eliminated, it stops boiling, we can reasonably conclude that there is a causal relationship between heat and boiling. It is better to say that believing in a causal relationship is more rational than believing in a frequent accident. As Lammer holds, Avicenna systematically develops the concept of experiment in contrast to the notion of induction to bridge the gap between induction and knowledge (Lammer, 2018, p. 46). It could be concluded that Avicenna has been aware of the limitations of induction. As McGinnisbelieves, "experimentation does not aspire to provide absolute *necessary* knowledge but only *conditional* necessary knowledge, albeit knowledge that can function as a first principle in a science" (McGinnis, 2003).

Avicenna's logical viewof natural laws

What experimental knowledge claims, should correspond to logical propositions which verify natural laws. The difference between accidental regularities and causal relations could be derived from some Avicennian logic. The difference is reflected in his logic by two kinds of propositions that comment on the nature of entities and merely refer to instances. These propositions that were later entitled real propositions (al-qaḍīahal–haqīqīyyah) and external propositions (al-qaḍīah al-khārījīyyah) have some roots in Avicenna's writings (Ardestani, 2011, p. 61). First, we ought to discuss his logical system briefly and then will consider the details in order to find some

implications about real propositions and external propositions. He generally divides propositions into two basic types:

1. Categoricals; atomic subject-predicate propositions, e.g.: A horse is an animal.

2. Hypotheticals; molecular propositions governed by a main connective, expressing a conditional or a disjunctive statement. For example, if it rains, the earth becomes wet.

Categorical propositions are subject-predicate propositions expressing a relationship or judgment between terms (Strobino, 2018). Considering the subject, there are three types of categorical propositions:

1. Mental propositions (*al-qaḍīah al-dhīhnīyyah*) that consider mental instances of the subject.

2. External propositions that consider the instances of the subject which exist right now.

3. Real propositions that consider the nature of the subject; whether it exists right now or not (Ardestani, 2011, p. 93).

The second is like what Avicenna presented as a hypothetical example of black people. One's assertion that "man is black" is true if, and only if, existent instances have been merely intended. As far as the laws of nature go, we think, what Avicenna believes is very similar to the third type of propositions, namely, real propositions although he has neither classified nor named them clearly. We will try to propose some evidence in favor of this idea and then explicate some of Avicenna's metaphysical points that provide a foundation for natural laws.

As noted earlier, Avicenna set an example regarding a law of nature, in which he discussed the nature of scammonia. He clearly differentiated it from a hypothetical one that deals with existent instances (black people example). So, in Avicenna's view, propositions concerning laws of nature express essential properties. He also, in *Shifa*, says that the premises of a demonstration should be universal. Then he counts several features for universal premises, one of which contends that the predicate should be ascribed to the subject at all times (Avicenna, 2012, p. 206). It is apparent that the predication in all times is more consistent with real propositions than others because it also considers future instances. For instance, "blackness" is not always predicated on "man." Similarly, "having a less than one mile diameter" is not the essential property of "gold" due to the fact that man could have been white and it is possible to collect a lump of gold having more than a one mile diameter, whereas scammonia is always purgative (unless some preventive factor exists) and every lump of uranium never has more than a one mile diameter.

Another evidence is when Avicenna, following Aristotle, points out some misunderstandings in the premises of demonstrations. He states that sometimes universal justice has a single instance, so one may think that the premise considers a particular subject and consequently, is not universal; for example, laws concerning the sun. It should be taken into account that according to Avicenna's physics, the sun is a universal thing that has only one instance. Avicenna believes that the sun implies a universal object and a substance that has one instance in the world. The demonstrations regarding the sun are true about all possible instances, whether there are one or thousands of them (Avicenna, 2012, pp. 223-227). He evidently aims at the nature of an entity. Consequently, his propositions about the sun (or generally about the natural world) are real propositions.

Other evidence is found in his physics, where he explains different types of motion in the material world with the assistance of tendency. The motion of matter is due to a tendency to conduct it to its natural place. As far as Avicennian physics goes, there are two types of material entities: simple and compound. Simple bodies are the Aristotelian classical elements, namely fire, air, water, and earth, which constitute compound entities. There are certain basic qualitative powers characterizing the four elements. These qualitative powers are 'hot' and 'cold', which are seen as active powers, and 'wet' and 'dry', which are seen as passive powers. Avicenna explains the motion of simple bodies by means of natural places which are determined by qualitative powers. The motion of compound bodies follows their prominent constituent elements (McGinnis, 2018).

As far as the celestial bodies are concerned, Avicenna believes in volitional motion over which an executive soul has control (Avicenna, 2015, pp. 729 & 730). So we will not discuss such a body. With respect to a terrestrial body, it moves toward its natural place unless an opposing force precludes or moves it away from its place (Avicenna, 2015, p. 261). As a result, unaccompanied by external forces, the motion originates froma mystical natural power. Here, Avicenna clearly explains a natural law by virtue of natural power and essential constituents.

Counterfactual propositions

Considering Avicenna's statements about the nature of entities, particularly those referring to the nature of the sun, it could be argued that Avicennian philosophical and logical systems are capable of justifying counterfactual propositions. The counterfactuals are about alternative ways things can be. For example, what might be true, and what isn't true but could have been (Starr, 2022) The counterfactuals tackle a state of affairs that does not exist in the

actual world. For instance, consider Newton's first law, namely the law of inertia which states that every object will remain at rest or in uniform motion in a straight line unless compelled to change its state by the action of an external force. The objects which are "at rest" are part of the subject of the propositions. Nevertheless, we know that the universe is expanding and there is no immobile object in the material world. In other words, the proposition presents some property of a subject that has no instance in the actual world, namely an immobile object.

Another instance is Kepler's first law which states that each and every planet moves in an elliptical orbit. One arising problem with such a statement is that not every individual planet moves in such an orbit in view of the fact that all actual planets are subject to interference by the gravitational attraction of the bodies which are orbiting beside the star. The law, in fact, asserts that if an actually planetless star had had a planet, then the planet would have moved in an elliptical orbit. Therefore, some of the propositions stating natural laws entail corresponding counterfactual conditionals (Lowe, 2006, p. 13).

The counterfactual propositions propose some formula by which we are able to analyze the possible state of the world. In philosophy, counterfactual modality has given rise to difficult semantic, epistemological, and metaphysical questions. The semantic question inquires how we communicate and reason about possibilities that are remote from the way things actually are, namely, the actual world. The epistemic approach seeks to realize how our experience in the actual world is able to justify thought and talk about remote possibilities and the metaphysical one questions whether these remote possibilities exist independently from the actual world, or are grounded in things that actually exist (Starr, 2022).

Since the discussion of counterfactuals is comprehensive, and considering all aspects deviate us from our aim, we will only discuss the counterfactuals concerning natural laws. Avicenna obviously declares that properties ascribed to the real sun, are true of all possible suns. At this point, he verifies some properties of some entities which do not exist in the actual world, namely, the other suns. Consider the actual sun has a property A. The logical form for other possible suns is:

● If there were other suns (in addition to or instead of the existent sun), they would possess the property A.

What creates the ability to make such a proposition is nothing but a real proposition. As far as the semantic question goes, the real proposition verifies some essential property of nature. When one asserts that "the sun has property A," owing to the fact that a real proposition considers both existing and possible instances of the subject, he/she is able to communicate the possible

instances by the common nature which exists in existing and possible instances. The epistemic question could be answered by finding the nature of entities through the accidental formula. The formula aids us in realizing the essential properties of entities. If our experience of the existent entities could provide enough evidence for recognizing the nature of entities (or at least essential properties), the idea and talk of remote possibilities will be plausible because the existents and the possibilities share in common nature. As some contemporary scholars hold, Avicenna's scientific method has been inspired by his metaphysics (Gohari & Ghazalifar, 2015). Therefore, we should seek metaphysical implications that suit aforesaid epistemology and logic.

We have discussed the epistemological and logical approaches to the Avicennian view on natural law which, in McGinnis' terminology, are entitled "logic" and the "objects of logic" (McGinnis, 2007). In the rest of the article, the metaphysical basis of this view, which involves truth-making and the truth-makers, will be analyzed and criticized. McGinnis also refers to this aspect of knowledge when he speaks of "science" and "the objects of science" (McGinnis, 2007).

Quiddity (*al-māhīyyah*) as a metaphysical foundation of real propositions

To accept some true, real propositions, which explain the nature of entities, we should seek some metaphysical truth-makers that provide the truth of these propositions. In Avicenna's works, we think, the best options that could be seen as truth-makers of real propositions are quiddities. Quiddity and existence (*wujūd)* constitute a crucial part of Avicenna's metaphysics. Quiddity refers to the whatness of entities. It determines how an entity is, what its existential borders and limitations are, and what its faculties and actuality are. Briefly, the quiddity is our response to the question of what is this entity. For instance, when one inquires "what is Avicenna?" We will respond that he is a "human being"' or, more comprehensibly, an "intelligible animal."

The concept of quiddity, Avicenna holds, differs from the concept of existence. As a result, quiddity and existence are not identical (Avicenna, 2015, p. 552). Every entity, save God, is metaphysically a compound of quiddity and existence. God is excluded because he does not possess quiddity and is pure existence. Avicenna believes that quiddity demands an external cause to become existent (Avicenna, 2015, p. 593) whereas God does not depend on anything; consequently, he has no quiddity.

The real propositions explain the nature of entities, regardless of the types of instances which occupy the external world right now. For instance, it states that "man could be white, " whether there is a white man in the actual world or

not. Since the particular instances in the world do not correspond to the subject of real propositions, we ought to search for another entity that provides a metaphysical basis for real propositions. The quiddity is capable of playing the role of the truth-maker of real propositions. To put it simply, quiddities qualify for corresponding factors for the subject of real propositions.

In Avicennian terminology, quiddity is sometimes identified with the "natural universal" (*al-kullī al-tabī'ī*). Choosing the natural universals as the truth-makers of real propositions manifests a controversial problem. Does world ontology contain the natural universal? To answer this question, we must discuss types of quiddities in Avicenna's works.

Types of quiddities

Quiddity, in the Avecinnian view, could be regarded in three ways. To clarify this idea, let us give an example. Suppose you want to consider a person, e.g., Avicenna. One way to regard him is with particular clothes; for example, Avicenna in white clothes. The second way is to consider him without any clothes. And finally, you could consider just him whether he wears any special clothes or not. The first option was conditioned with special clothes and the second was conditioned without any clothes. In the third one, you regard him unconditionally. Similarly, a quiddity, like ahuman being, could be regarded in three ways: we can regard the humanity that a particular person like Socrates possesses. It is called the particular quiddity in which both the quiddity and its association with a particular instance (here, Socrates) are considered. Particular quiddities occupy the external world (outside of the human mind). We also are able to regard quiddity on the condition of nothing else. This is the mental quiddity that only exists in the mind because whatever exists in the external world comes with other things (properties). These two kinds of quiddities are regarded conditionally. The first is accompanied by a particular instance and the second is not accompanied by anything else. So both of them carry a condition while the third one, neither includes accompaniment to a particular instance nor requires the lack of it. Quiddity in the last case is called 'quiddity qua quiddity' or 'quiddity in itself' or the "natural universal". Does quiddity qua quiddity exist in the external world? A positive answer by Avicenna could contribute to the metaphysical basis for which we are searching.

Severely rejecting Platonic ideas, Avicenna believes the essences of entities are not separated (Avicenna, 1997, pp. 327-338). Considering the essence as quiddity qua quiddity, he holds that an essence, for example, horseness in itself, is nothing but horseness. If one asks "is horseness A?" We will answer it is neither "A" nor "not A" (Avicenna, 1997, p. 200). Because when we

consider horseness in itself (the third type of consideration), it does not contain unity (*waḥdaẗ*), plurality (*kathrat*), having property A, not having property A, and whatever, but horseness. We noted that the third type of quiddity (quiddity qua quiddity) neither includes accompaniment to a particular instance nor requires the lack of it. Owing to the unconditionality of quiddity in itself, nothing accompanies it. Therefore, horseness is neither single nor plural even though there are a lot of horses in the external world and the horse in the mind (its concept) is unique.

Avicenna argues that there are sensible humans or animals in the external world (we use the last example, horseness, to explain Avicenna's idea). When we analyze a sensible quiddity, it contains pure quiddity and some accidents (or properties). The sensible horse incorporates horseness and some accidents (its color, size, and other properties). Therefore, horseness (pure quiddity) is part of a particular horse (Avicenna, 1997, pp. 203, 204) or a particular horse is horseness plus some properties. If a whole (a particular horse) exists in the external world, its parts exist in the world as well due to the fact that a whole does not exist unless all of its parts exist. A genus, for example, an animal, exists in the types that are under it, for example, human, horse, and eagle. In the same manner, humanity exists in Socrates, Plato, Aristotle, and so forth. A pure essence cannot exist by itself in the external world. There is no entity that is nothing but humanity. To clarify, in every instance, there is both essence and sensible quiddity. For instance, Socrates is a person (an instance of human) who possesses the nature of humanity (type).

Pure quiddity and natural laws

Avicenna describes nature (*al-ṭabīʿah*) as a reference of change and being at rest (Idem, 1908, p. 86). Considering another principle in Avicennian philosophy, which holds that change merely lies in physical entities, it could be concluded that immaterial entities do not possess nature. Nature, in Avicenna's philosophy, plays the role of form (or quiddity). It determines the causal power which everybody possesses. In other words, nature is the origin of the changes that an entity could accept. For instance, the nature of fire causes light and heat in spite of the earth. It is the quiddity of fire and earth that accounts for their different influences. Similarly, the nature of compound bodies is affected by the nature of their elements. Thus, the quiddity of natural objects determines the natural laws which rule over them.

There are many laws governing entities discussed in medicine, natural philosophy, etc. The laws express something concerning the nature of entities. They do not solely refer to particular instances, but also to both existent and hypothetical ones. To give an idea, when a law contends that fire burns wood,

it does not mean that all fires are burning (or will burn) wood. It expresses something about the nature of fire and wood. In other words, existent fires have the power to burn some existent piece of wood. In addition, if there were another piece of fire, other than the existing ones, it would have the power to burn the aforementioned piece of wood too.

We think that what Avicenna holds regarding the quiddity, could be seen as the truth-maker of propositions expressing the laws of nature. A natural law indicates the natural power of entities. So, when we assert that scammonia purges bile, in fact, we claim that a property (purging bile) characterizes nature (orthe quiddity of scammonia). Such a statement is a real proposition because it considers both existing and hypothetical scammonias. The 'quiddity in itself' is able to ensure that objects of logic map onto objects that exist only in the external world, namely, objects of science. It bridges the gap between these two worlds. McGinnis holds that the unconditional quiddity allows Avicenna an answer to an important question, namely, "what bridges the gap between these two worlds?" (McGinnis, 2007).

Conclusion

Avicenna's natural philosophy seeks the essential accidents (*al-aʿrāḍ al-dhātīyyah*) of the sensible body insofar as it is subject to change. He states that logicians sometimes use essentials to refer to the predicate which attaches to the subject due to the subject's substance and quiddity. Examples of this are proportion and equality which belong to measurements or their genus, evenness and oddness which belong to numbers, and health and disease which belong to animals. These sorts of essentials are properly called "essential accidents."(Avicenna, 2013, p. 145). Essential accidents manifest the natural capabilities of bodies by which they enter into a causal relationship. Similarly, other fields like medicine, chemistry, and mathematics also seek essential accidents of the subject.

Where an epistemological approach is concerned, natural law is associated with experiential and intuited propositions. We noted that, in Avicenna's view, repeated observations could result in universal and certain verification provided that it discloses the natural properties of entities. These properties are identified as essential accidents. The argument is rooted in a formula that asserts that permanent (or frequent) events may not be accidental. It should be taken into account that Avicenna has been aware of the restriction of the human ability in recognizing the nature of entities (Avicenna, 1984, p. 34). Thus, he admits that experimentsdo not generate complete certainty. However, it provides a plausible basis that justifies our belief in the causal relationships which entities have.

In addition, we indicated that real propositions provide the logical basis for ideasand discussions concerning essential accidents. Therefore, resorting to real propositions, we are able to refer to properties that originate from the nature of entities in spite of external propositions that merely consider existent instances. In the Avicennian context, the difference between these two types of propositions has been indicated by two examples: "scammonia purges bile" and "man is black." The first one refers to the nature of scammonia while in the second one, the blackness is only true of existing instances in a hypothetical situation that Avicenna puts forward. Accordingly, there is a consistency between the Avicennian approach in logic and epistemology. What he asserts in experiential propositions could be phrased in the form of real propositions which provide the certainty and universality of verifications. Although such propositions have not been titled by Avicenna, we find some evidence that proves he has paid attention to the differences between real propositions and external ones.

Considering the differences between conception and verification, Avicenna holds that verification involves knowing the meaning or form of a word, statement, or the inference occurring in the mind, in addition to "that the relation of this form to the things themselves occurs in the mind, namely, that [the things in themselves] map onto [the form in the mind]."(Avicenna, 1984, p. 17).

Every true proposition must correspond with the external world. Put differently, there should be some metaphysical entities in the external world that play the role of the truth-maker of our true propositions. As real propositions do not directly deal with existent instances (we emphasize directness because real propositions deal with existing instances through their nature), the particular instances are not appropriate for truth-making. But the quiddity in itself (the natural universal) could form a metaphysical foundation for real propositions. The natural universals are the essences of entities. The nature of entities could be considered the truth-maker of real propositions and also the criterion for distinguishing accidental generalizations from universal laws, in addition to being the truth-maker of real propositions. He asserts that natural universals exist in the external world.

Avicenna considers scientific knowledge as an understanding of the underlying causal structure of the world, which is done primarily through a logical analysis of empirical data, where this analysis involves identifying the middle term ultimately required for rational thought. He introduces the quiddity in itself as something common to both the objects of rational thought, and their concrete instances, and the causal interactions among them, which are the objects of scientific inquiry (McGinnis, 2008). Therefore, correspondence between mental and actual worlds is provided by the essence

considered in itself. Avicenna's philosophy has formed a consistent system in which natural laws are recognized by experiential propositions, stated by real propositions, and become true by the natural universal or quiddity in itself.

Ethics declarations

Conflict of interests

The authors have no competing interests.

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