

Henrik Lagerlund

(The University of Western Ontario)

Abstract.

In this paper, I introduce Arabic logic and outline three distinctive features of Avicenna's logic. I also place Arabic logic in the context of Western Medieval logic and point to a few areas where Arabic logic seems to have had an influence on Western logic.

ملخص

أحاول في هذه المقالة التعريف بالمنطق العربي و توضيح ثلاث خصائص لمنطق ابن سينا. كما أقوم أيضا بوضع المنطق العربي في سياق المنطق الغربي الوسيط مع التأكيد على بعض النقاط التي يبدو أنّ المنطق العربي قد ترك أثره فيها على المنطق الغربي.

Résumé.

Dans cet article, je présente la logique arabe et j'esquisse un aperçu des trois traits distinctifs de la logique d'Avicenne. Je place également la logique arabe dans le contexte de la logique médiévale occidentale, tout en montrant les points sur lesquels la logique arabe semble avoir influencée la logique occidentale.

Arabic logic begins in the mid-eight century. It has its foundation in Ancient Greek logic – foremost in Aristotelian logic. The Syriac Christians adopted a teaching tradition in logic that included Porphyry's *Isagoge*, *Categories*, *De interpretatione* and the first seven chapters of the *Prior Analytics* (these are the chapters that include the non-modal theory of the syllogisms). This teaching tradition was taken over and spread through the Arab conquest in the seventh century. In the following centuries during the Abbasid Caliphate (750-1258), there was a continuously growing interest in philosophy and logic. It is this time period that is often referred to as the golden age of Arabic philosophy and logic.

Gradually the whole *Organon* (the logical works of Aristotle) was made available in Arabic translation.

The first more important logician in this tradition is Ishâq al-Kindî (d. 870). He wrote a short overview of the whole of the *Organon*. After him more and more substantial works were produced. Abû Nasr Alfarabi (d. 950) makes the first more original contributions. He wrote a series of commentaries on the *Organon*. Avicenna held his work in very high esteem. Unfortunately, most of his commentaries are lost. By far the most important logician in the Arabic tradition was, however, Avicenna (d. 1037).

Avicenna's Logic

Avicenna had a different attitude to Aristotle's logic than logicians before him. He didn't think that Aristotle was necessarily right. Aristotle had a lot of intuitions about logic that didn't all go together into a coherent whole. They had to be worked out and then it would become clear, Avicenna thought, that Aristotle's logic was only a fragment of a much larger system. Up until Avicenna, logic was in the Arabic tradition dominated by Aristotle's influence, but after him logic was Avicennean. This isn't to say that logic wasn't Aristotelian after Avicenna. It was, but the texts drawn upon by most logicians weren't Aristotle's – they were Avicenna's (a formidable exception was, of course, Averroes). One work in particular became especially important for subsequent logicians. It was what is known as *Al-Ishârât wa'l Tanbîhat* in Arabic and *Pointers and Reminders* in English.

In some of his works on Avicenna's logic, Tony Street has outlined three things that make logic Avicennean as opposed to Aristotelian.

- (1) The truth-conditions of absolute (or assertoric, that is, non-modal) sentences are expressed in modal terms.
- (2) The logical properties of so-called descriptonal (*wasfi*) sentences, like 'Every B is A while B', are studied.
- (3) Syllogisms are divided into connective and repetitive.

If a logician adopts these three, he is following Avicenna, according to Street (see Street 2002 and Street 2004).

In pointer two of path four, Avicenna introduces the distinctions between different kinds of sentences. The first distinction is between absolute and modal sentences. Although absolute sentences are distinguished from modal sentences they turn out to be modal as well. The basic division is one between absolute sentences that are taken to be definite and indefinite with respect to time.

Avicenna talks about three kinds of absolute sentences, and they are all explicated with the help of time. First there are absolute sentences that refer to a definite time. They play no role in his discussion. The other two are more important and they are the general and the special absolute sentences.

The general absolute sentences are sentences taken without limitation with respect to time, which means that they have to take in all individuals—past, present and future. Furthermore, the copula 'is' is taken to mean that the B's are A's at least sometime. An example would thus be 'Every human being is sometimes moving'. A special absolute sentence is hence a sentence with limitations with respect to time. The subject term hence refer to individuals at a specific moment in time—although it is not explicated what moment in time that is. The copula is also understood as a conjunction meaning 'sometimes B and sometimes not B'. An example would be 'Everything running is sometimes walking and sometimes not walking'.

Avicenna is quick to point out that neither general nor special absolute sentences behave as expected. They for example don't fit in to the traditional square of opposition. 'Every B is A' on the general reading doesn't contradict 'Some B is not A'. He therefore brings in one other kind of absolute sentence, namely a perpetual absolute sentence. In the perpetual sentence the copula is simply read as 'is always'. The contradictory of the general absolute is going to be a perpetual absolute, and similar with the special although it will contradict a disjunction of two perpetual sentences (see Street 2002 and Lagerlund 2009 for a more detailed discussion about this).

The second distinctive Avicennan thesis is the introduction of descriptive sentences. This is again done in the context of modal logic, although, such sentences don't need to be modal at all and Avicenna can be seen to have introduced a logic for descriptive sentences (Street 2002). The example he gives in *Pointers and Reminders* is:

(D) 'Everything walking is necessarily moving while walking'

The addition of 'while walking' restricts all moving things to those actually walking, which makes the sentence true. Avicenna distinguishes descriptive sentences from substantial sentences. The example he gives of a substantial sentence is:

(S) 'Every human is necessarily an animal'

The logic for substantial sentences is different from the logic for descriptive sentences. A sentence like (S) converts according to the standard Aristotelian conversion rules, like:

'Every human is necessarily an animal'

into:

'Some animal is necessarily a human'.

These kind of sentences are characterized by being *kath' hauto* (*per se*) as described by Aristotle in *Posterior Analytics* I.4 (see Lagerlund 2000, 30-1). Part of what Aristotle said about modal logic is valid for such sentences. Another group of sentences, like:

'Every grammarian is necessarily a human'

aren't substantial and hence don't convert, since this converted sentence is false:

'Some human is necessarily a grammarian'.

However, if these are read as descriptive sentences, then they do convert, like:

'Every grammarian is necessarily a human while a grammarian',

which converts into:

‘Some human is necessarily a grammarian while a grammarian’.

Descriptive sentences hence have a logic like substantial sentences and Avicenna thinks part of Aristotle’s modal logic can be worked out using descriptive sentences. I have compared this to some similar logics found in thirteenth century Latin logic (see Lagerlund 2009). Even though Avicenna sketches a logic for descriptive sentences in *Pointers and Reminders*, he is mostly concerned with substantial sentences and their logic.

The third distinctive mark of Avicenna’s logic is the distinction between so-called connective and repetitive syllogisms. It corresponds roughly to Aristotle’s distinction between categorical and hypothetical syllogisms.

In his newly published history of Arabic logic, Khaled El-Rouayheb divides Arabic logic after 1200 into several distinctive periods (see El-Rouyaheb 2011). The immediate following period outlined in the book starts in the early thirteenth century with Fakhr al-Din al-Razi. He divides the logical tradition into an early and a later tradition. After Razi the Arabic logical tradition became disassociated from Aristotle and more narrowly focused on the predicables, definitions, propositions and syllogisms. Most thirteenth century logic can also be described as post-Avicennan in the sense that they all took their departure from Avicenna and not from Aristotle himself.

In the fourteenth century another transformation takes place and lengthy summaries found in the earlier traditions became very rare. Instead of writing commentaries on the works of Aristotle, Arabic logicians were content with writing glosses. The interest also shifted from formal logic (syllogisms) to semantical concerns.

After this period Arabic logic fragments in the fifteenth and sixteenth centuries and several centers develop. In the book, El-Rouyaheb identifies an Ottoman Turkish, an Iranian, an Indo-Muslim, a North African and a Christian Arabic tradition. These developed independently of each other, and, according to El-Rouyaheb, it is the Ottoman Turkish tradition that is the most important. This fragmentation continues up to

the twentieth century. It is mostly the themes outlined by Avicenna that dominates the tradition, however.

The Influence of Arabic Logic

Arabic logic had very little influence on the Western logical tradition after the Middle Ages. In fact it was largely forgotten until rediscovered by Nicholas Rescher in 1964 (see Rescher 1964). Carl Prantl argued in the mid-nineteenth century that the part of Western logic nowadays called *logica modernorum*, the so-called theories of the properties of terms, that is, supposition theory etc. from the twelfth century, entered into the Latin world from translations of Byzantine and Arabic logical works (see Prantl 1867). This was, as M.L. de Rijk showed in the 1960's, completely wrong (see de Rijk 1962 and 1967). He argued convincingly that this part of medieval logic was partly due to Aristotle's *Sophistici Elenchi* but foremost it was due to the creative minds of late twelfth century logicians. His judgment of earlier views was so harsh, however, that Arabic logic in the Latin tradition has hardly been studied at all. Most scholars are of the opinion that Arabic logic had very little if any influence on Western logic, but, although Arabic logic didn't revolutionize Western logic as was once thought, it certainly had an influence on the Western logical tradition; although not in the way previously thought.

The Latin logicians of the thirteenth century had quite a good grasp of Arabic logic. The major source for this knowledge was the *Maqâsid al-falâsifa* (The Meaning of the Philosophers) by Abû Hâmid Muhammad al-Ghazâlî (1058-1111). It was supposed to be a preparatory work for his later and for contemporary readers much more known *Tahâfut al-falâsifa* (The Incoherence of the Philosophers). The whole of the *Maqâsid* contains a presentation of logic, physics, metaphysics and theology, and has been claimed to be an intelligent reworking of foremost Avicenna's *Dânesh-name* (Book of Science), which is a compendium of his doctrines written in Persian. Al-Ghazâlî's work was translated in full into Latin early in the second half of the twelfth century, which isn't more than 50 or 75 years after it was written. In one of the manuscripts the title is *Liber Algazelis de summa theoricæ philosophiæ*, but it was also printed in Venice in 1506 under the title *Logica et philosophia Algazelis arabis*.

The Latin translation of the *Maqâsid* was very much read and became together with Maimonides' *Guide*, at least in the thirteenth century, the basic text from which the Latin authors gained their knowledge of Arabic philosophy. The reason it became so much read was because it mentions some of the 'hot' topics of the period, for example the divisions of the sciences, the distinction between essence and existence, the eternity of the world, the number of souls etc. The logic became very well known as well. Albert the Great used it quite extensively and it was used or copied by Ramón Lull.

Al-Ghazâlî begins the *Maqâsid* with a distinction between imagination (*imaginatio*) and belief (*credulitas*). An imagination is an apprehension of a thing, he writes, which is signified by a single mental utterance (*dictio*) in the intellect. Names like 'stone' or 'tree' etc. signify these apprehensions or imaginations. A belief is on the other hand a sentence or a complex utterance, that is, that which says or expresses something, like 'the world begins'. A belief is always a composition of at least two imaginations. The kind of knowledge, which is mediated by imagination, is arrived at through definitions and descriptions, and the kind of knowledge, which is mediated by belief, is arrived at through arguments. It is logic that gives the rules by which we are able to give good and true definitions and arguments. Hence logic is the very foundation of knowledge and all science, argues Al-Ghazâlî.

The major thing to note about this division is the close connection between mind and logic. The view of logic as being about intentions is derived from Avicenna and it was very influential. It gave rise to a major controversy in the thirteenth century between those that argued that logic was a science of discourse (*scientia sermocinalis*) and those that argued that it was a science of reason (*scientia rationalis*). Albert the Great argues, for example, that logic is a science of mental intentions.

The Arabic discussion of the matter of the syllogism found in Al-Ghazâlî's logic is of particular interest. His division of the matter had an influence on several Latin logicians and among them Thomas Aquinas. The matter of a syllogism is its premises while the form is the syllogistic form.

He gives the following division of the matter:

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- Demonstrative premises,
- Topical premises,
- Rhetorical and legal premises,
- Sophistical premises,
- Poetical premises.

Logic is hence subdivided into these five kinds of matter.

Although the *Maqâsid* was a summary of Al-Farabi's and Avicenna's doctrines, the Latin medieval logicians also had some knowledge of Al-Farabi's and Avicenna's logics directly. A twelfth century translation of the beginning, namely the part on Porphyry's *Isagoge*, of Avicenna's encyclopedic worked called in Arabic *Kitab al-Shifa* (The Book of Healing) was circulating, and also a fragment of the part on the *Posterior Analytics* from the same book existed in Latin. Small fragments of some of Al-Farabi's logic works have also been discovered in Latin.

In the early thirteenth century, some of Averroes' commentaries on the *Organon* were translated in to Latin. William of Luna translated the middle commentary on Porphyry's *Isagoge* and the middle commentaries on Aristotle's *Categories*, *De interpretatione*, *Prior Analytics*, and *Posterior Analytics* between the 1220's and 30's.

In many commentaries on Aristotle's logical works in the thirteenth century a heavily metaphysical interpretation of logic is defended. There has been some discussion in the secondary literature about the source of this interpretation and one suggestion is that it has its source in Averroes' commentaries. His view of *differentia* can be found in Robert Kilwardby's commentaries on the *Isagoge* and the *Categories*. It can also be read into Aquinas' *De ente et essentia*. Averroes' treatment of modal syllogistics is also very interesting and strengthens his general metaphysical interpretation of Aristotle's logic. It seems also to have had some influence in the thirteenth century, particularly on

Kilwardby's commentary on Aristotle's *Prior Analytics*. A detailed study of the logical theories in Arabic logic works accessible to Latin logicians has not been written yet. It is clear, however, that these doctrines never were as influential as Prantl assumed, but neither did they exert no influence what so ever (See Lagerlund 2000, Chapter 2, Lagerlund 2007 and Lagerlund 2011).

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