Avicenna on the Opposition of Conditional Proposition

"Many theses in mathematics, physics and metaphysics
are conditionals, connective or disjunctive." Ibn Sînâ

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Introduction

Broadly speaking, a conditional is a complex proposition that is composed of, at least, two categorical propositions bound together by the connectors "if-then" or "either-or". The founder of logic as a formal discipline, Aristotle (d. 322 BC), contributed little to the development of conditionals. While speaking of the arguments that cannot be proved by a syllogism, he lightly touches upon the arguments yielding the conclusion on the basis of a hypothesis, but he resigns himself to promising to deal with these in detail elsewhere.[1] We have no clear evidence that Aristotle managed to keep his promise.[2] Yet, we observe that within the Peripatetic school, some en-

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1 Aristotle, *Prior Analytics I*, trans. & commentary G. Striker (Oxford, 2009), 50a39-b2. According to Alexander (fl. 200 AD.), Aristotle "would be referring to hypothetical <arguments> through an implication (which also called a conditional) and an additional assumption, and those through a disjunctive or disjunction, or those through a negative conjunction" Alexander of Aphrodisias, On Aristotle's Prior Analytics 1.32-46, trans. I. Mueller (London, 2006), pp. 84-85.

2 Classical view on this issue is that nothing was written by Aristotle on the conditional syllogisms, or, if any, it is extinct. See W. W. Fortenbaugh et al., Theophrastus of Eresus: Sources for His Life Writings Thought and Influence, ed. & trans. W. W. Fortenbaugh et al. (Leiden, 1992), pp. 237 ff. Also in the Arabic logicians like al-Fārābī (d. 950) and Avicenna, we can see some tinges of this uncertainty. While al-Fārābī mentions somewhere Aristotle's work on the conditional syllogisms, he states elsewhere that the commentators alleged that Aristotle had had some books on them. See al-Fārābī, *Kitāb al-Jam' bayna Ra'yay al-Hakīmayn*, ed. A. N. Nādir (Beirut, 1968), p. 86; *Sharh al-Fārābī li-Kitāb Arisṭūṭālīs fī al-Ibāra*, ed. W. Kutsch & S. Marrow (Beirut, 1971), p. 53. Avicenna's stance on the issue is not clear, however, we can maintain, with Shehaby, that he thinks that Aristotle wrote a book on this topic, but it got lost. See Avicenna, *al-Shifā al-Manṭiq IV* al-Qiyās, ed. S. Zayed (Cairo, 1964), p. 397; N. Shehaby, *The Propositional Logic of Avicenna,* (Dordrecht-Boston, 1973), p. 5.

terprises were sought to make up for this deficiency. Aristotle's own disciple and immediate successor in the Lyceum, Theophrastus (d. c. 287 BC), developed wholly hypothetical syllogisms and designated terminology in this field of study for the first time.[3] The most ground-breaking improvements of the subject in ancient times, however, were recorded by a group of thinkers known as the Stoics. Shaped mainly by Chrysippus (d. c. 206 BC), on the basis of the Megaric philosophy,[4] the Stoic logic represents an alternative and rival approach. The Stoic logic, essentially a propositional logic unlike Aristotle's term logic,[5] is of enormous importance in the history of the logic of conditionals particularly due to the Stoic debates over the nature of conditional propositions.[6]

As a product of prolonged controversies between the Peripatetic and Stoic schools –with occasional reconciliations– the Greek philosophical and logical legacy was transmitted into the Islamicate cultural environment by the Greco-Arabic translation movement.[7] A part of the Greek legacy, the logic of conditionals attracted the attention of Arabic logicians,[8] though not as much as the Organon texts and commentaries. Foremost among them is, unquestionably, Avicenna (Ibn Sînâ, d. 1037). As opposed to his

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3   Of Theophrastus' logical works, only a number of fragments and testimonies are extant, mostly in Alexander and other commentators. For detail, see Theophrastus of Eresus: *Sources for His Life Writings Thought and Influence*, ed. & trans. W. W. Fortenbaugh et al. (Leiden, 1992),237 ff.; J. Barnes, "Theophrastus and Hypothetical Syllogistic", *Theophrastus of Eresus*, ed. W. Fortenbaugh et al. (New Jersey, 1985), pp. 125 ff.; P. *Huby, Theophrastus of Eresus Sources for His Life Writings Thought and Influence II Logic* (Leiden-Boston, 2007), pp. 135 ff.

4   For the relation between Megaric philosophy and Stoic logic, see W. Kneale & M. *Kneale, The Development of Logic*, (Oxford, 1988), pp. 113-17; J. Sellars, *Stoicism* (Durham, 2006), p. 56.

5   Aristotle's logic is regarded as a 'term logic', because it explores the containment relations between the classes referred to or expressed by terms. See C. Shields, *Aristotle* (London & New York, 2007), pp. 118-119. For a comparison between Aristotelian term logic and Stoic propositional logic see, J. W. Stakelum, *Galen and the Logic of Proposition* (Romae, 1940), pp. 12-13; J. S. Kieffer, *Galen's Institutio Logica* (Baltimore, 1964), pp. 8-9; Sellars, *Stoicism*, p. 60.

6   Kneale & Kneale, *The Development of of Logic*, pp. 113-14; İ. Çapak, *Stoa Mantığı ve Farabi'ye Etkisi,* (Ankara, 2006), p. 28.

7   For a detailed picture of this intellectual enterprise, see D. Gutas, *Greek Thought Arabic Culture*, (New York, 1998).

8   Although almost all of the Aristotelian texts were translated and commented on several times by Arabic scholars, we have no evidence that any text of Stoic Logic translated into Arabic. See M. Bayrakdar, *İslam Felsefesine Giriş,* (Ankara, 1998), p. 56.

Muslim-Arabic predecessors, Avicenna does not confine his task as a logician to understanding, and commenting upon, the Organon. As a result of his willingness to move beyond sectarian borders when necessary, Avicenna greatly benefited from other sources, such as the Neo-Platonic and Stoic traditions.[9]

In this paper, I shall discuss Avicenna's views on conditional propositions in general and the oppositional relations between them in particular. It has three parts. In the first, I will deal with Avicenna's definitions and classifications of propositions and then conditional propositions. In the second part, I will focus on Avicenna's approach to the quality and quantity of the conditional propositions, and in the third part, on the oppositions of them. In this paper, I shall try to identify Avicenna's sources as much as possible, paying particular interest to the Stoics and Galen (d. 216). My aim is to show that, compared with his Greek and Arabic predecessors, Avicenna has a considerably more developed and comprehensive theory of conditional propositions that significantly carries this field of logic further. I shall try to prove that, as opposed to Rescher's[10] conviction, Avicenna's theory is essentially peripatetic, not stoic and that, pace Shehaby and Maróth,[11] it is not a propositional logic and truth-functional, but perhaps an extension of Aristotle's terminist logic and its application to the conditionals.

1. The Classification of Conditional Propositions

Avicenna describes a proposition (qaḍiyya) as "every sentence that establishes a relationship between two things and is appropriate to the judgment of truth or falsity".[12] The proposition composed of these 'two things' in the descriptive sentence is 'categorical' (ḥamliyya) if they are simple concepts, but it is 'conditional' (sharṭiyya) when they are propositions too,

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9   A. I. Sabra, "Avicenna on the subject matter of logic", *The Journal of Philosophy*, 77 (1980), 746–64, p. 749; T. Street, "Arabic Logic", *Handbook of the History of Logic I*, ed. D. M. Gabbay & J. Woods (Amsterdam, 2004), 523-596, pp. 535-536; L. E. Goodman, *Avicenna* (London & New York, 1992), p. 184.

10 See N. Rescher, "Avicenna on the Logic of Conditional Propositions", *Notre Dame Journal of Formal Logic IV/1* (1963), 48-58.

11 Both Shehaby and Maróth give their books on Avicenna's theory of conditionals a title that suggests their common idea that Avicenna's theory is a propositional logic suitable to read truth-functionally. See N. Shehaby, *The Propositional Logic of Avicenna and M. Maróth, Ibn Sīnā und Die Peripatetische "Aussagenlogik"* (Leiden, 1989).

12 Ibn Sīnā, *Kitāb al-Najāt*, ed. M. Fakhrī (Cairo, 1985), p. 50.

not simple terms. In other words, when the copula is removed, if two simple terms remain, then the proposition is categorical, these terms being its subject (mawḍūʿ) and predicate (maḥmūl). On the other hand, if two or more propositions remain, then the proposition is conditional where these sentences form its antecedent (muqaddam) and consequent (tālī) respectively.[13] To give some examples, while the proposition 'Man is an animal' is categorical, 'If the sun rises, then it is day' and 'Either this number is even or it is odd' are conditional ones.[14]

Categorical and conditional propositions have both common and different features. To mention the common ones first, (1) both propositional forms need to have a truth value, that is, to be true or false. This point differentiates propositions from other forms of sentences that cannot be true or false, such as questions, commands, prayers, and vocations.[15] (2) Both include an implicit judgment that the meaning of a proposition corresponds to the external world. For Avicenna, every proposition is conceived first in itself and in this stage it is a conception that is not true or false. Only when we attach a belief about whether its meaning corresponds to the external

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13 It is interesting as an evident to show non-Stoic character of Avicenna's theory that, as opposed to the Stoics and Galen, Avicenna does not regard 'and' as a connector and does not include the copulative propositions into his classification. We therefore cannot see the copulatives in his system at all. It is because "Avicenna did not develop his theory of quantified conditionals in order to give an account of five Stoic indemonstrables" K. I. Karimullah, *Avicenna (d. 1037), Logical Theory, and the Aristotelian Tradition*, Ph.D. Thesis (McGill University, 2014), p. 9.

14 Ibn Sīnā, *al-Ishārāt wa al-Tenbīhāt maa Sharh Nasīr al-dīn al-Tūsī*, ed. S. Dunyā (Cairo, 1971), p. 223; *al-Shifā al-Manṭiq III* al-Ibāra, ed. M. al-Khudairī (Cairo,1970), p. 32. The terms muqaddam and tālī, never occuring in the Arabic translations of the Organon, appear to have been transmitted into Arabic through works of the Commentators and to be defined for the first time by Avicenna. The muqaddam, Avicenna says, is the first part of every conditional proposition to which the conditional word attaches and whose response is anticipated and the tālī is the second part of the sentence or the response of the muqaddam. See Ibn Sīnā, *al-Shifā al-Manṭiq IV* al-Qiyās, ed. S. Zayed (Cairo,1964), p. 233; al-Najāt, p. 81; S. M. Afnan, *Avicenna His Life and Works* (London, 1958), p. 98.

15 Having a truth value is a prerequisite in order a sentence to be a proposition according to both Aristotle and Stoics. See Aristotle, *Categories and De Interpretatione*, trans. with notes by J. L. Ackrill (Oxford, 1963), 16b35-36; B. Mates, *Stoic Logic*, pp. 27-28. As for the important question, what is the ground of being true, Avicenna's answer is that there are two factors: the meaning of the sentence and the states of affairs as is found in the world. If the former corresponds to the latter, then the proposition is true. See Shehaby, *The Propositional Logic of Avicenna*, p. 220.

truth, it becomes an assertion and gets a truth-value.[16] (3) In both categorical and conditional propositions, it is asserted or denied that there is a certain kind of relationships between two things and the most fundamental difference between the two forms of propositions has to do with the nature of this relationship. In the categorical propositions, it is asserted that the predicate belongs to the subject, or, the subject is the predicate just as in 'S is P'. This relation is called 'predication'. On the other hand, in the case of the conditional propositions, the antecedent either implies the consequent, if the proposition is connective, or conflicts with it, if the proposition is disjunctive. These relations are called 'implication' and 'conflict' respectively.[17] The categorical propositions that make up the conditional one are no longer truth-bearers, so it is just the conditional as a whole that can be true or false.[18]

With respect to the relation it expresses, a conditional proposition is either connective (muttaṣila) or disjunctive (munfaṣila). In the connective-

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16 The implicit judgment of a proposition suggested herein by Avicenna is regarded as the fourth component of propositions by later Arabic logicians and raises some quarrels. They argue that the copula has two functions: connecting two elements of the proposition and expressing that this connection is in line with the external reality. See Quṭb al-dīn al-Rāzī, *Taḥrīr al-Qawāid al-Manṭiqiyya Sharh al-Risāla al-Shamsiyya,* (Cairo,1948), p. 86. For a recent review of the medieval discussions of Arabic logicians about parts of categorical propositions, see K. El-Rouayheb, "Does a Proposition Have Three Parts or Four? A Debate of Later Arabic Logicians", *Oriens 44* (2016), 301-331. It seems to me that Avicenna's distinction between conception and assertion of a proposition anticipates the notion of propositionality that is ascribed to Peter Abelard (d. 1142) and called 'Frege Point' later on. See C. Martin, "Logic", *The Cambridge Companion to Abelard*, ed. J. E. Brower & K. Guilfoy, (Cambridge, 2004), 158-199, pp. 166 ff. Martin, however, acknowledges somewhere the possibility that Arabic logicians may have been aware of the Frege point. See C. Martin, "The Logic of Negation in Boethius", *Phronesis XXXIV/3* (1991), 277-304, p. 281.

17 For the origins and logical signification of the terms 'implication' (ittibā/ akolouthia) and 'conflict' (taānud /mache), see Kieffer, *Galen's Institutio Logica*, pp. 76-82; S. Bobzien, "Peripatetic Hypothetical Syllogistic in Galen – Propositional Logic off the Rails", *Rhizai 2* (2004), 57-102, pp. 62 ff.

18 Ibn Sīnā, *al-Qiyās*, pp. 231-232; al-Ishārāt, p. 225. The last contention means that for Avicenna, a conditional proposition as a whole is asserted categorically, not conditionally. This accounts for his attempts to apply the features of categorical propositions like quality and quantity to the conditionals as well and to construct categorical syllogisms out of conditional propositions. See Shehaby, The Propositional Logic of Avicenna, p. 221. Just as in some other points, Avicenna agrees with Boethius (d. 524) in that the conditional proposition is a single statement-making sentence, hence involves only one judgment. From Boethius, we learn that Porphyry (d. 305) disagrees with them, so the target of Avicenna's objection here is quite likely to be Porphyry. For the details of Boethius' account, see T. Suto, *Boethius on Mind, Grammar and Logic* (Leiden-Boston, 2012), p. 163.

conditional propositions, for Avicenna, the consequent follows from the antecedent and they are linked to each other by the connector 'if-then'. The paradigm example frequently used by Avicenna is 'If the sun rises, then it is day'. Disjunctive-conditional propositions marked by the occurence of the connector 'either-or' signify a stark contrast and incompatibility between their components. Avicenna gives 'Either this angle is acute, or it is obtuse, or it is right' as an example of disjunctive propositions.[19]

This classification of conditional propositions and the preferred terms suggest that Avicenna's stance on the subject is essentially Peripatetic.[20] According to Alexander and Galen, the Peripatetics made use of the term 'hypothetical' to distinguish conditional propositions from the categorical and assorted them as 'hypothetical by connection' and 'hypothetical by separation'. We learn from them also that the Stoics used the 'conditional' to refer only to the connective-conditionals.[21] Avicenna, however, does not absolutely keep to the Peripatetic nomenclature, since he prefers the Stoic term 'conditional' to the Peripatetic 'hypothetical' and uses it to cover both connective and disjunctive propositions.[22]

Yet calling both connectives and disjunctives as conditional raises a problem: The connective-conditional proposition reasonably deserves the title 'conditional' since it involves a protasis and its apodosis, but why are we entitled to call the disjunctives that do not contain any condition as conditional? The Peripatetics, Galen reports, expressed the relation

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19 Ibn Sīnā, *al-Ishārāt*, p. 225.

20 Among recent scholars of Avicenna, Maróth and Karimullah, who cites him, agree that Avicenna's terminology is similar with the Peripatetics and Boethius probably because they used the same sources. See Karimullah, *Avicenna* (d. 1037), *Logical Theory and the Aristotelian Tradition*, p. 30.

21 Alexander of Aphrodisias, *On Aristotle's Prior Analytics 1.1-7*, trans. J. Barnes et al. (New York, 1991), p. 56; Galen, "Institutio Logica", in Kieffer, Galen's Institutio Logica, 31-54, p. 33. For a more detailed comparison, see Bobzien, "Peripatetic Hypothetical Syllogistic", p. 216.

22 Although he is aware that connective-conditionals could be called 'hypothetical', Avicenna never uses this terminology. See Ibn Sīnā, *Manṭiq al-Mashriqiyyīn wa al-Qaṣīda al-Muzdawija fī al-Manṭiq* (Cairo,1910), p. 61; *al-Ishārāt*, p. 225. Similarly, "although the early Stoics knew the term 'hypothetical', they did not apply it to propositions, as was done in subsequent centuries" Stakelum, Galen and the Logic of Proposition, p. 19.

of conflict and incompatibility within the form of 'if-then' propositions with a negative antecedent. For example, 'If it is not night, then it is day' is a connective-conditional according to "those who attend to the words alone", because it is in the conditional form of speech, but it is a disjunctive proposition according to "those who attend to the nature of the facts", since it says that when one thing does not exist another does.[23] In other words, for the Peripatetics, the connective-conditional with a negative antecedent or consequent is equivalent to a disjuntive-conditional proposition.[24] This might account for why both are covered in the same title, i.e. 'conditional'.

Being aware that disjunctives could be stated in a connective form,[25] Avicenna avoids deducing one form to another and argues that there are a number of significant differences between connective and separative-conditionals. The first difference is that, contrary to those of disjunctive, the antecedent and consequent of the connective proposition cannot be exchanged with each other without changing the meaning of the whole proposition. The second difference, for him, is that the antecedent of the connective is in harmony with its consequent, but this is not the case in the disjunctive-conditionals either. Probably considering these differences between the two forms, Avicenna offers another solution to the problem instead of Galen's. For Avicenna, in the case of disjunctives, when the connector 'either' is attached to the antecedent and, 'or' to the consequent, they no longer are propositions in themselves and therefore have truth values. Only when the antecedent and consequent are bound together does

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23 Galen, "Institutio Logica", p. 34. By "those who attend to the words alone" Galen means the Stoics, and by "those who attend to the nature of the facts" the Peripatetics. See Kieffer, *Galen's Institutio Logica*, pp. 66 ff.; S. Bobzien, "Pre-Stoic Hypothetical Syllogistic in Galen's Institutio Logica", The Unknown Galen, ed. V. Nutton (London, 2002), 57-72, p. 64. For the fact that Boethius, too, expresses disjunctives in the connective-conditional forms, see Suto, *Boethius on Mind, Grammar and Logic*, p. 143.

24 This fact shows, Bobzien says, "that the Peripatetics did not have a syntactic definition of hypothetical premises. What determined whether a premise is connecting [i.e. connective-conditional] or dividing [i.e. disjunctive-conditional] is the relation that it is assumed to hold", so early Peripatetic approach is semantic, not syntactic. See Bobzien, "Pre-Stoic Hypothetical Syllogistic in Galen's Institutio Logica", p. 72.

25 "One may indicate the plain conflict within connective or predicative forms" Ibn Sīnā, *al-Qiyās*, p. 244. Cf. Shehaby, *The Propositional Logic of Avicenna*, pp. 225-26.

the proposition composed of them have a truth value, and in this sense, disjunctives are conditional.[26]

According to the nature of following and conflict, Avicenna divides the conditional propositions into sub-classes as 'complete' and 'defective'. If its antecedent and consequent implies each other, the connective-conditional proposition is complete. It is defective if only its antecedent implies the consequent. To give an example, the afore-mentioned proposition 'If the sun rises, then it is day' is complete, since that the sun rises implies its being day and vice versa. Yet, 'If this is a man, then it is an animal' is defective, because 'this is a man' implies 'it is an animal', but not vice versa. The disjunctive proposition, Avicenna argues, is complete when there is so flat a contradiction between its components that each part could be replaced by the contradictory of the other. 'Every number is either even or odd' is a complete proposition in this sense. Conflict is defective whenever the elements of the disjunctive-conditional do not contradict each other, as in 'Six is either perfect or over-perfect'. For if the number is not perfect, it need not be over-perfect; it may be defective.[27]

Avicenna's complete connective- and disjunctive-conditionals appear at first sight not to be interrelated, but if we restate both of them, as Galen suggests, in a connective form, it is clearly seen that they are somehow equivalent. To use Avicenna's example of complete conflict, the proposition 'Either the number is even or it is odd' is equivalent to 'If the number is not even, then it is odd', which shows that this is an example of a proposition of complete connection since its components mutually imply each

26 Ibn Sīnā, *Avicenna's Treatise on Logic Part One of the Danesh-name Alai*, ed. & trans. F. Zabeeh (The Hague, 1971), pp. 25-26; *Manṭiq al-Mashriqiyyīn*, p. 61; Nasīr al-dīn al-Tūsī, *Sharh al-Ishārāt wa al-Tenbīhāt*, in Ibn Sīnā, al-Ishārāt at page bottoms, p. 224; Shehaby, *The Propositional Logic of Avicenna*, pp. 215-16.

27 Ibn Sīnā, *al-Qiyās*, pp. 232-33. Avicenna's perfect connective-conditionals are the same as the logical equivalence of modern logicians. But, from a formalistic point of view, there is a difference between them. "Modern logicians use a special kind of functor, but in Avicenna's logic complete connection is expressed in two implications thus: if p, then q and if q, then p" Shehaby, *The Propositional Logic of Avicenna*, p. 12. Incidentally, for the terms 'perfect (telos)', 'over-perfect (hypertelos)', and 'defective (ellipsis)' often used to qualify numbers by Arabic logicians, see Euclid, *The Thirteen Books of the Elements II*, trans. T.L. Heath (Cambridge, 1908), pp. 293-94.

other. Avicenna's most probable source, Galen, says that 'It is either night or it is day' is complete and equivalent to 'If it is not day, then it is night'.[28]

Considering the nature of following, Avicenna distinguishes the connective-conditional propositions into two classes:

(1) Implication (luzūm): The antecedent of any connective-conditional may imply the consequent in two ways: (a) the posited antecedent requires per se that the consequent should follow it. In the paradigm example, 'If the sun rises, then it is day', the protasis 'the sun rises' implies both in existence and thought that it is indeed day. This may result from either that the antecedent is the cause that brings the consequent into existence, as is the case in the example just mentioned; or that it is an inseparable effect of the consequent, just as in 'If it is day, then the sun rises'; or that they are correlate; or that both of them are effects of the same cause that implies them together. For example, thunder and lightning are effects of the movement of wind in the clouds. (b) It is also possible, Avicenna maintains, that the antecedent implies the consequent only in existence, not in immediate thought. In such a case, the antecedent can never come into existence without being accompanied by the consequent because either the antecedent necessitates the consequent or vice versa; or both are necessitated by the same fact; or they are correlatives.[29]

In both cases, there is a logical and/or factual relation between the two elements of implication, but, in accordance with his well-known essence-existence distinction,[30] Avicenna takes into account, in the former case, only logical consequence that also holds in the external world. In the latter case, however, his criterion requires the existence of an extra-mental reality, whose causal nexus is not necessarily comprehended by immedi-

28 Galen, "Institutio Logica", pp. 34-35. According to Zimmermann, the two correlative pairs of concepts (complete/incomplete consequence-complete/incomplete conflict), among the known Greek texts accessible to Arabs, occur only in Galen's Institutio Logica. See. F. W. Zimmermann, *Al-Farabi's Commentary and Short Treatise on Aristotle's De Interpretatione,* (Oxford, 1981), p. lxxxiii. It is, therefore, quite reasonable to assume that al-Fārābī and Avicenna drew those concepts from Galen. For al-Fārābī's account of those terms, see al-Fārābī, "Kitāb Qātāghūriyās ay al-Maqūlāt", *al-Manṭiq ʿinda al-Fārābī I*, ed. R. al-ʿAjam (Beirut, 1985), 89-131, pp. 127-29.

29 Ibn Sīnā, *al-Qiyās*, pp. 233-34.

30 For this distinction, see Ibn Sīnā, *al-Ishārāt*, p. 154.

ate thought, or hold in the accidental, not essential, aspect of things. For example, the concept 'man' implies the concept 'rational' both in thought and existence. This implication holds in thought because rationality is a part of the human essence and we cannot think of man without thinking of his being rational. It is true also in existence because there is no man in the world that is not rational. On the other hand, 'man' implies 'a-creature-that-laughs' only in existence, due to that the latter (a-creature-that-laughs) is not a part of the essence of the former (man) and attaches to it as a concomitant after it comes into existence.[31]

(2) Chance connection (ittifāq): Avicenna deals with another class of the connective-conditional propositions that signifies neither logical nor causal consequence. In such propositions, for example, 'If human exists, then horse exists', there is no detectable or significant relation between the antecedent and consequent.[32]

The essential difference between implication and chance connection appears most clearly in their truth conditions. But firstly I would like to point out that Avicenna avoids ascribing any truth-value to the antecedent of the conditionals because, for him, the phrases 'if it is' or 'when it is' are not used to indicate something exists or not although their literal form is generally thought to refer that. These phrases, Avicenna says,

"indicate, whenever used in a conditional proposition, that something is assumed, without any concern over whether this assumption corresponds with reality or not. Therefore, it is clear that we should not expect the antecedent as an antecedent to correspond with reality, for it is only an assumption. When this assumption is specified; it may either be true in itself; or true in relation to some other assumption; or suspended, namely that we ignore the question of its truth [or falsity] altogether. When we say that it is an assumption, we do not mean that it is actually assumed or it will be assumed in the future. What it means is that if our assumption is correct,

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31 Shehaby, *The Propositional Logic of Avicenna*, p. 227.

32 Ibn Sīnā, *al-Qiyās*, p. 234. Similarly the Latin logicians from Boethius on classify the connective-conditionals into 'natural' and 'accidental'. See Suto, Boethius on Mind, Grammar and Logic, p. 166; D. Bonevac &J. Dever, "A History of the Connectives", *Handbook of the History of Logic XI: Logic: A History of its Central Concepts*, ed. D. M. Gabbay et al. (Amsterdam, 2012), 176-233, p. 191.

than what follows from it must be correct. If the impossible is assumed and made an antecedent, then there will be nothing in it but the fact that it is an impossible assumption."[33]

This view of Avicenna is in line with the Stoic doctrine that regards the hypothetical expressions, like 'if it is day', as ambiguous and does not include them into the class of propositions that is necessarily true or false. Furthermore, according to Chrysippus, a conditional proposition which is formed by the conditional connector 'if' indicates only that the consequent follows from the antecedent. But, an inferential proposition which is introduced by the connector 'since', for example 'Since it is day, it is light', guarantees both that the consequent follows from the antecedent and the latter is really a fact.[34]

According to Avicenna, the consequent, on the other hand, must be taken to be true and existent with the existence of the antecedent. When it is said, for example, 'then it is day' after saying 'if the sun rises', this means that the judgment 'it is day' is true with the assumption 'the sun rises'.[35]

Implicational propositions, Avicenna thinks, are true if and only if the antecedent implies logically or factually the consequent, whether both are true or false in themselves. Accordingly, any proposition with a true antecedent and a true consequent, for example, 'If man exists, then void does not exist', is false, if construed as implication, since its former part does not imply the latter. But, the proposition 'If man is not an animal, then man is not sensitive' whose components are both false, will be true, if it is construed as an implication, because its consequent is implied by its antecedent. A true antecedent and false consequent together, however, could never

33 Shehaby, *The Propositional Logic of Avicenna*, p. 68. For the discussions in the Post-Avicennan tradition of Arabic logic on the impossible antecedents, see K. El-Rouayheb, "Impossible Antecedents and Their Consequences: Some Thirteenth-Century Arabic Discussions", *History and Philosophy of Logic*, 30 (2009), 209-225.

34 D. Laertius, *Lives of Eminent Philosophers I*, trans. R. D. Hicks (London & New York, 1925) p. 175; pp. 180-181; Stakelum, *Galen and the Logic of Proposition*, p. 18-19.

35 Ibn Sīnā, *al-Qiyās*, p. 271.

make up any true connective-conditional proposition, due to the fact that truth never implies falsity.[36]

Conversely, the truth value of propositions expressing a chance connection is determined by the truth value of the consequent: if it is true, then the proposition is true as well; if it is false, the proposition is false too. This is so, because, as was said before, the antecedent is asserted hypothetically and taken to be true. Accordingly, 'If every donkey talks, then every man talks' is true, if construed as a chance connection, because the consequent is true in itself.[37]

Some other differences, related to the terminology, exist between implication and chance connection. According to Avicenna's nomenclature, the terms 'connection' or 'following (ittibā')' may refer to either kind of propositions when used absolutely, but only to implication when Avicenna states explicitly that they are used in the strict and real sense. Furthermore, while Avicenna exclusively uses the terms 'protasis (sharṭ)' and 'apodosis (jazā)' in reference to the elements of implication, the terms 'antecedent' and 'consequent' are used by him in both cases.[38] It is possible, therefore, to suppose that where the terms 'protasis' and 'apodosis' occur, Avicenna has an implication in mind.

As for the disjunctive-conditional propositions, Avicenna, like Galen, divides them into three sub-classes, which differentiates him from the Stoic logicians who recognize only the first one of the following classes:

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36 Ibid., pp. 238-41, 273. From this account, it becomes evident that, for Avicenna, the truth value of the implicational connective-conditionals is perfectly contingent upon whether or not the relation it expresses holds and he does not regard such propositions as truth-functional. He says "… in conditional propositions, it is the relation between their parts [i.e. the antecedent and consequent], that we only consider, not the relation between the parts of their parts [i.e. subject and predicate]" Ibn Sīnā, al-Qiyās, p. 261. This words remind us of those of Alexander: "… in hypothetical propositions truth and falsity depend not on something's being said of something but rather on implication and conflict" Alexander, On Aristotle's Prior Analytics 1.1-7, p. 56. We cannot see anything that has to do with the truth-conditions of conditional propositions in Galen's Institutio Logica. The Stoics, on the other hand, consider the conditionals truth-functional. For them, therefore, the truth value of conditionals inevitably depends upon the truth value of their components, particularly because of which Avicenna differs from the Stoics once again. For the Stoic account, see Sextus Empiricus, *Against the Logicians*, trans. R. Bett (Cambridge, 2005), pp. 112, 137-38; Mates, *Stoic Logic*, pp. 43-44.

37 Ibn Sīnā, *al-Qiyās*, p. 270.

38 Ibn Sīnā, *al-Qiyās*, pp. 237-38; Shehaby, *The Propositional Logic of Avicenna*, p. 226.

(1) Exclusive or real disjunction: Such propositions have two contradictory components, one of which necessarily true while the other false, for example, 'Either the number is even or it is odd'.

(2) Defective-exclusive disjunction:[39] These propositions have one aspect of exclusiveness: they may not be true together, but may be both false. For example, the parts of the proposition 'Either this is inanimate or it is an animal' may not be true together, because there is nothing that is both inanimate and animal at the same time. Yet, they may be both false, since it may be neither inanimate nor an animal, and may be, say, a plant.[40]

(3) Inclusive disjunction: The components of the inclusive disjunctives can be true together, but at least one of them has to be true. According to Avicenna, in such propositions, one of the parts of a real separation has been replaced with a more general consequence. For example, in 'Either Zaid is in the sea or he is not drowned', the consequent 'he is not drowned' has superseded the contradictory of the antecedent, i.e. 'he is not in the sea'.[41]

I have so far tried to explain how Avicenna defines and classifies conditional propositions, and now I shall focus my attention on the characteristics related to the quality and quantity of such propositions.

2. The Quality And Quantity of Conditional Propositions

The quality of a proposition amounts to its being positive or negative. If the proposition asserts that the relation between its subject and predicate holds, then it is positive. But, if it says that there is not such a relation, then

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39 Galen calls these 'quasi-disjuntives' (Galen, "Institutio Logica", p. 35) and regards them to be equivalent to the Stoic negation of conjunction, on which the Stoic third indemonstrable depends. For Galen's criticism of this argument, see Galen, "Institutio Logica", p. 46-47.

40 Ibn Sīnā, *al-Qiyās*, pp. 242-43. According to Goodman, these disjunctive propositions are one of the two that found by H. M. Sheffer as adequate for the construction of all other truth functional connectives. But Avicenna "does not note any special importance for it. He does not see his task as one of reducing all logical relations to a single, simplest formal usage. Rather, his goal is faithfully and flexibly to reflect the variety of natural relations to which the syntax of natural language is sensitive" Goodman, Avicenna, p. 204.

41 Ibn Sīnā, *al-Ishārāt*, p. 252. In Avicenna's theory, the inclusive disjunctive propositions may not be composed of positive propositions and he requires that at least one of them is negative. While in *al-Qiyās*, he uses disjunctive propositions with two negative parts, in al-Ishārāt, his examples have one positive and one negative part. See Ibn Sīnā, *al-Qiyās*, pp. 244, 247. Galen's examples for such propositions, on the other hand, have positive parts and he thinks that these propositions express defective connection. Hence they are like the connective-conditionals in this respect. See Galen, "Institutio Logica", pp. 36, 47 ff.

it is negative. Quantity of a proposition, on the other hand, depends upon the degree to which the asserted relationship between its parts holds: it is universal if the assumed relationship is about each and every member of the class designated by the subject-term and it is particular if it is merely about some members of the subject class. We shall see in the following section how Avicenna applied to the conditionals these features that had widely been regarded as peculiar to the predicative propositions.

As for the quality of conditional propositions, at the outset Avicenna criticizes two widely-accepted views. The first is that the connective-conditional is similar to the affirmative and the disjunctive is similar to the negative proposition, and there is no affirmation and negation in conditionals, because only the antecedent or consequent may be affirmed or negated. To reject this view, Avicenna maintains that just as the truth value of the conditional proposition is not contingent upon that of its parts, so too is its quality independent from that of its parts. Furthermore, connective- and disjunctive-conditionals have both positive and negative forms. While the affirmative connective asserts that its consequent follows from its antecedent, the negation denies that. On the other hand, while the affirmative disjunctive-conditional confirms the relation of conflict between its parts, the negative denies the existence of that relation. For example, the negation of the connective proposition 'If the sun rises, then it is day' is not a disjunctive, even if it implies a disjunctive as its consequence.[42]

The second view Avicenna rejects is the notion that in order to negate a conditional proposition, one must just negate its consequent. In other words, what determines quality of any conditional is that of its consequent. This is to say, a conditional proposition is negative if its consequent is negative, and positive if positive.[43] Contrary to this, Avicenna thinks

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42 Ibn Sīnā, *al-Qiyās*, pp. 258-259. We can find some traces of the view Avicenna rejects in both Boethius and al-Fārābī. For Boethius, the conditional propositions are neither affirmative nor negative because they do not predicate anything of anything. See Martin, "The Logic of Negation in Boethius", p. 283. al-Fārābī states that affirmation and negation hold for both the predicative and conditional propositions, but he gives a connective as an example of affirmative conditional and a separative for negative conditional. See al-Fārābī, "Kitāb al-Qiyās", *al-Manṭiq 'inda al-Fārābī II*, ed. R. al-'Ajam (Beirut, 1986), 11-64, p. 13; "Kitāb al-Qiyās aṣ-Ṣaghīr", *al-Manṭiq 'inda al-Fārābī II*, ed. R. al-'Ajam (Beirut, 1986), 65-93, p. 83. Since his works did not reach to the Arabic logicians, Boethius could not be one of Avicenna's targets. But, from that Boethius and al-Fārābī adopt this view, we arguably draw the conclusion that in the Peripatetic tradition, this view was common and prevalent.

43 For Kaukua's mistaken attribution of this account of negation to Avicenna, see J. Kaukua, "Avicenna on Negative Judgment", Topoi (2016). For the fact that this view also can

that a conditional proposition with negative consequent is still affirmative, since in such a proposition, negation does not have to do with the whole proposition, but constitutes just a part of consequent. To negate a conditional proposition, therefore, one has to deny the existence of the relation of implication or conflict between two components and to negate whole proposition, not its consequent. The negation of 'If the sun rises, then it is day' is 'Not: if the sun rises, then it is day' and the negation of 'Either this is an articulate creature or it is a creature-that-laughs' is 'Not: either this is an articulate creature or it is a creature-that-laughs'.[44]

Avicenna's appropriation of this conception of negation comes at the expense of disagreement with his Peripatetic predecessors,[45] and may have resulted from the Stoic notion of negation (apophatikon).[46] The Stoics, like Avicenna, argue that it does not suffice to negate only the consequent in order for the proposition to be negative. Rather, they argue that having the negation particle prefixed to the proposition, we both make it encompass and negate the whole proposition and avoid some possible ambiguities in the process.[47]

Nevertheless we can explain Avicenna's insistence on prefixing the negation particle to the proposition by referring to his general approach to the conditionals, without any reference to the Stoics. For unlike the Stoics, he does not think of the conditional proposition as two propositions that are just bound together with a connector. Instead, Avicenna argues that only one proposition that its sub-propositions has made up within a process of merging and evolving to a new one. The components of any conditional are no longer propositions, after being used as either anteced-

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be found in Boethius, see H. Chadwick, Boethius, the Consolations of Music, Logic, Theology, and Philosophy (Oxford, 1981), p. 169; Martin, "The Logic of Negation in Boethius", p. 296.

44 Ibn Sīnā, al-Qiyās, p. 259.

45 For the criticism of this notion by Alexander, the commentator, see Alexander, On Aristotle's Prior Analytics 1.32-46, pp. 99 ff.

46 Rescher believes that Avicenna's conception of negation is a natural consequence of the Stoic distinction between negation and denial which reached him after being blurred through translations and exegeses. See N. Rescher, "Avicenna on the Logic of Conditional Propositions", p. 56. For this distinction, see Mates, Stoic Logic, p. 31; S. Bobzien, "The Stoics", The Cambridge History of Hellenistic Philosophy, ed. K. Algra et al. (Cambridge, 1999), 92-176, pp. 101-102.

47 Sextus, Against the Logicians, pp. 106-107; S. Bobzien, "Logic", The Cambridge Companion to the Stoics, ed. B. Inwood (Cambridge, 1990), 85-123, p. 90.

ent or consequent, since they are not true or false as such any more. This accounts for why and how Avicenna constantly likens the conditionals to the predicatives and applies the features of the latter to the former.[48] He claims, therefore that just as the quality of a predicative proposition is not determined by the quality of its subject or predicate, but by the existence of predication, so too is the quality of the conditionals independent from that of its components and determined by the existence or non-existence of the relationship it designates. So, as regards with quality of the conditional, one must consider only the relation between its parts, not the relation between their own parts.[49]

In the quantity of the conditional propositions too, Avicenna departs from the widely-accepted opinion[50] and draws an explicit analogy between the temporal operators prefixed to conditionals and quantifiers in categorical propositions.[51] For him, what makes any predicative proposition universal, particular or individual is the quantity of predication, not the quantity of its subject or predicate; if it states, for example, that the predication holds for each and every member of the subject, then it is universal. Similarly, the quantity of any conditional proposition depends on the quantity of the relationship it asserts. Accordingly, if the connective proposition affirms or denies a connection between the antecedent and consequent in any state or under any condition,[52] then it is universal, affirmative or negative respectively. The disjunctive-conditional is universal affirmative, if

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48 "In definiteness, indefiniteness, contradiction and conversion, you must see the connective and disjunctive conditionals as you would see predicative ones, with the antecedent as a subject and the consequent as a predicate" Ibn Sīnā, *al-Ishārāt*, p. 254.

49 Ibn Sīnā, *al-Qiyās*, pp. 260-61; Shehaby, *The Propositional Logic of Avicenna*, p. 225. Avicenna's conception of negation, I think, raises a problem whether his negative conditionals are still 'conditinal'.

50 "…being universal, particular and indeterminate are features peculiar to predicative propositions" Alexander, *On Aristotle's Prior Analytics 1.1-7*, p. 56. As is clear, the Peripatetic tradition does not consider quantity of the conditionals. Only the predicatives that make up the conditional have quantity and it is their quantity that determines quantity of the conditional in turn.

51 El-Rouayheb, "Impossible Antecedents and Their Consequences", p. 210.

52 In accordance with his treatment of mental existance as a proper mode of existance, Avicenna does not stipulate realization in time and "quantifies [the conditionals] over mentally supposed states (aḥwāl) or conditions (shurūṭ) that may or may not ever be realized at any time t, and, in fact may not even be realizable". Karimullah, Ibid., p. 9.

the conflict it expresses obtains under every circumstance, real or mental, and it is universal negative if the conflict obtains never and under no real or supposed circumstances. The universal quantifiers used by Avicenna are 'always' and 'never' prefixed to the whole proposition. For instance, the propositions 'Always: when A is B, then C is D' and 'Always: either it is such or it is so' are universal.[53] Now, neglecting the individual and indefinite propositions that do not have any functions in the traditional square of opposition, I shall deal with the universal and particular conditional propositions.

In the universal affirmative form of connective-conditional propositions, for example 'Always: when A is B, then C is D', the quantifier 'Always: when' is meant to generalize over the occurrences of the statement, as in 'Every time A is B, then C is D.' But, on Avicenna's account, it also generalizes over the conditions that may be added to the antecedent. This is to say, there is no condition or state that may be added to the antecedent which does not make 'C is D' true when it makes 'A is B' true.[54] The universal negative, on the other hand, means that under no circumstances does the antecedent imply the consequent or does the consequent follow it, but its truth conditions may vary in accordance with its being an implication or chance connection. In the implication, the negation amounts to that the antecedent never/by no means implies the consequent. Negative chance connection, however, confirms that the antecedent and consequent cannot be true together because the consequent is never true in itself. Whether or not the antecedent is true is not crucial since it already is assumed to be true. To give an example, 'Never: when man exists, then void does not exist' is true, if construed as an implication, and false if construed as a chance

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53 Ibn Sīnā, *al-Qiyās*, pp. 262-263. Avicenna rejects the view that any affirmative universal connective proposition whose antecedent and consequent has the same subject, like 'Always: when this is a man, then he is an animal' is equivalent to an affirmative universal predicative one, like 'Every man is an animal'. They are not equivalent, because the conditional one clearly refers to an individual, but the predicative does not. It would be, then, more reasonable to accept that the predicative equivalent of that conditional is 'This man is an animal', but in this case, the universality of 'Always: when' gets lost. As a result, if the universality is added to the proposition, then the individual is ignored and vice versa, so it is not true to consider them equivalent. For the argument in detail, see Ibid., p. 264.

54 *Ibid.*, p. 265.

connection, because the antecedent never implies the consequent, but they are true together.[55]

Avicenna obtains the particular connective-conditionals with prefixes 'sometimes' and 'not always' for affirmative and negative respectively. He thinks that in some cases, we can infer the truth of the particular from the truth of its universal, since what is true of universal is true of its particular, too. Nonetheless in the cases when the universal is not true, the particular might be true. For instance, 'man' is not truly predicated of every animal, but is true of some animals, hence the truth of 'Some animals are men'. While discussing such propositions, Avicenna resorts to the modal notions 'necessity' and 'possibility'. For him, in 'Sometimes: if this is an animal, then it is a man' the antecedent necessarily implies the consequent sometimes when this 'animal' is an articulate animal. On the other hand, the antecedent of 'Sometimes: if this is a man, then he is a creature-that-writes' sometimes possibly implies its consequent, but not necessarily. For this reason, such propositions may be reasonably counted as a chance connection, not implication.[56]

In particular negative connective-conditionals, Avicenna confines himself to stating that they can be understood considering the universal negative and particular affirmative ones. His examples are 'Not always: if A is B, then C is D' and 'Not always: if the sun rises, then it is cloudy'.[57]

As for the quantity of the disjunctive-conditionals, it can be stated first that Avicenna delimits the discussion to the exclusive propositions and only occasionally touches upon the other two types: defective-exclusive and inclusive disjunctives. Among the exclusive disjunctives, the universal affirmative proposition is true as long as there always be a conflict between its components.[58] Of the universal negative statements, Avicenna says, the most difficult is that which has two universal affirmative parts and such propositions are true in following three cases:

(1) As in the proposition 'Never: either every man talks or every donkey brays', both two components may be always true.

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55 *Ibid.*, pp. 280-81.
56 *Ibid.*, p. 276.
57 *Ibid.*, pp. 280, 283; *Avicenna's Treatise on Logic Part One of the Danesh-name Alai*, p. 26.
58 Ibn Sīnā, *al-Qiyās*, p. 283.

(2) As in the proposition 'Never: either every man brays or every donkey talks', both two components may be always false.

(3) As in the proposition 'Never: either every man is an animal or void exists', one of the parts is always true and the other is an impossible which is neither in conflict with nor does its contradictory implies the former part. 'Void exists' in the example is impossible, but neither it contradicts with 'every man is an animal' nor does its contradictory 'void does not exist' entails it.[59]

If a universal negative proposition has two negative parts (antecedent and consequent), then it may be false in each of the three cases above. For example, 'Never: either A is not B or C is not D' is false, according to Avicenna, if its components are not in conflict and may be true together.[60]

Avicenna maintains that the particular disjunctive-conditional indicates that there sometimes exists a conflict between its parts. It might be composed of universal propositions, which is usually the case when a general law is specialized with some certain conditions. For instance, the proposition 'the every quantity is either equal to or less or more than another quantity' is a general law that has three parts. Nevertheless if one excepts one of them and asserts that it is not equal to another, then we have a disjunction with two parts. In this case it is true to say that 'Sometimes: either every quantity is less or it is more than another one'. With an assumption also, these propositions may be true. For example, 'Sometimes: either anyone is on the ship or he is drowned' is true if it is assumed that he is on the sea.[61]

On the particular negative disjunctive-conditionals, we cannot find any elaboration in Avicenna's works, but it is clear from a few examples he gives that he develops such propositions with the prefix 'Not always' as is the case in the connective-conditionals.[62]

I hope to have so far shown that Avicenna constructs his theory of conditional propositions applying the quality and quantity to them,[63] and his

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59 *Ibid,* p. 284.

60 *Ibid.*, pp. 285-86.

61 *Ibid.*, pp. 289-90, 376.

62 For example, see Ibn Sīnā, *Avicenna's Treatise on Logic Part One of the Danesh-name Alai*, p. 27.

63 One of Avicenna's significant contributions to the logic of conditionals, I think, is his efforts to interpret the conditional propositions in general and connective ones in particular in terms of modality. For his accounts for the modal conditional propositions,

theory is considerably more comprehensive and advanced than those of his Greek and Arabic predecessors whose works are available to us.[64]

Lastly I shall center on how we should understand Avicenna's logic of conditionals in terms of the traditional square of opposition.

3. The Opposition of Conditional Propositions

It is a well-known truism from Aristotle onwards that from a pair of predicative propositions with the same subject and predicate, according to their quality and quantity, there arise four logically significant and necessary relations, contradiction, contrariety, subalternation and subcontrariety. Yet before Avicenna, Greek and Arabic logicians largely failed or neglected to take into consideration these relations in the conditional propositions. In this section, I shall explain how Avicenna defines these relations and then, as is common in the logical traditions, try to schematically show his theory of the oppositional relations between the conditional propositions depending upon what has been said in the previous sections.

The strongest opposition,[65] contradiction, on which Avicenna's discussions of opposition focus most, is the relation of two statements with the same subject and predicate that differ both in quality and quantity so much so that one of them should be necessarily true and the other false. Of contradictory propositions, only one must be universal, so if both are universal, then they are contraries and may be false together, but they cannot both be true. If both are particular, then they are subcontraries and as opposed to contraries they may be both true, but cannot be false together.[66]

Like Aristotle, Avicenna does not define subalternation,[67] but occasionally informs us about the subaltern propositions. For him, if the uni-

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see Ibn Sīnā, *al-Qiyās*, pp. 291-92. As far as I know, modality of the conditional propositions was not dealt with by Greek or Arabic logicians before Avicenna and found somehow odd by some logicians like al-Tūsī (d. 1272), the great thirteenth-century Arabic philosopher and the commentator of Avicenna. He says that it has been not customary to modify the relationship between the antecedent and consequent with possibility and necessity (al-Tūsī, *Sharh al-Ishārāt*, p. 260). He, however, discusses modalized conditionals, particularly connective conditionals, in his. See al-Tūsī, *Asās al-Iqtibās fī al-Manṭiq I*, trans. to Arabic Mulla Khusraw (Cairo, 2004), pp. 188-193.

64 See Rescher, "Avicenna on the Logic of Conditional Propositions", p. 53.

65 For enumeration of the logical oppositions according to their strength, see S. Chatti, "Logical Oppositions in Arabic Logic: Avicenna and Averroes", *Around and Beyond the Square of Opposition*, ed. J. -Y. Béziau & D. Jacquette (Heidelberg, 2012), 21-40, pp. 25-26.

66 Ibn Sīnā, *al-Najāt*, pp. 63-4.

67 The Arabic rendering of subalternation (tadākhul) is, Chatti claims, an Avicennian coinage, since it did not occur before him. See Chatti, "Logical Oppositions in Arabic

versal is true, then its particular subaltern is necessarily true, and if the particular is false, then its universal is necessarily false, but not vice versa in either case. That is to say, neither the falsity of the universal implies that of particular, nor does the truth of the particular suffice for the universal to be true.[68]

Avicenna's stance on the oppositional relations between the conditional propositions is in complete harmony with his general conception of the conditionals: these relations exactly correspond to those of predicative propositions and depend on the quality and quantity of the propositions, not those of their parts. This means that if the antecedent of any proposition contradicts the antecedents of another one or its consequent contradicts that of the other, these are not actually contradictory. For example, 'Always: when Zaid goes for a walk, then he runs across Amr' is not the contradiction of 'Always: when Zaid goes for a walk, then he does not run across Amr'. These statements are contraries and may be both false, but not true, because each of them is equivalent to the other's contrary.[69] To clarify, we can indicate this equivalence that is reminiscent of obversion in modern logic[70] as follows:

Always $(P \to Q) \equiv$ Never $(P \to \neg Q)$, the contrary of 'Always $(P \to \neg Q)$'

Always $(P \to \neg Q) \equiv$ Never $(P \to Q)$, the contrary of 'Always $(P \to Q)$'.

Avicenna seems to draw an analogy between the conditional proposition with a negative consequent and the predicative one which has a metathetic predicate.[71] For him, as said before, to negate a predicative proposition, it is not enough to negate its predicate, because when the negated or metathetic predicate is affirmed of the subject, the proposition is still

Logic: Avicenna and Averroes", p. 27.

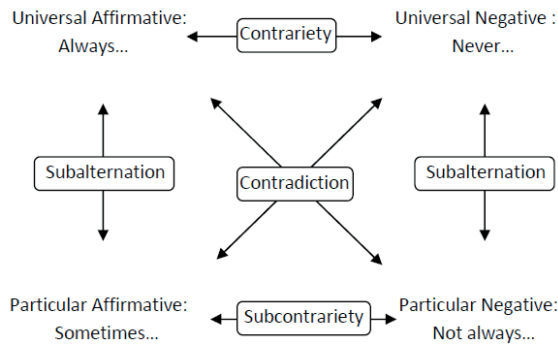68 Ibn Sīnā, *al-Qiyās*, p. 372.

69 *Ibid.*, p. 362, 368.

70 For the obversion of the conditional propositions, see J. Welton, *A Manual of Logic I* (London, 1922), pp. 271 ff. For the fact that Avicenna frequently uses obversions to show the equivalences between the conditionals, see Ibn Sīnā, *al-Qiyās*, pp. 363 ff. This equivalence, though mistakenly attributed to Boethius, seems likely to have been formulated by Abelard for the first time in the Latin tradition. See Martin, "The Logic of Negation in Boethius", p. 303. Avicenna, however, explicitly formulated it a century earlier and it seems to have gained wide acceptance in the Arabic tradition until the end of the twelfth century. See El-Rouayheb, "Impossible Antecedents and Their Consequences", pp. 209-10.

71 For this term, see Zimmermann, *Al-Farabi's Commentary and Short Treatise on Aristotle's De Interpretatione*, p. lxiii.

affirmative. Instead, we must negate the whole proposition.[72] By the same token, to obtain the contradiction of any conditional proposition, one needs to negate whole proposition. Therefore the contradiction of the afore-mentioned proposition 'Always: when Zaid goes for a walk, then he runs across Amr' is 'Not always: when Zaid goes for a walk, then he runs across Amr'.

In the light of what has been said, I think, we can indicate Avicenna's account of the oppositional relations between the conditional propositions as in the following scheme:

Scheme 1: The square of opposition for the conditional propositions:

Universal Affirmative: Always... — Contrariety — Universal Negative : Never...

Subalternation — Contradiction — Subalternation

Particular Affirmative: Sometimes... — Subcontrariety — Particular Negative: Not always...

Primarily based upon the function of the temporal quantifiers, this scheme shows us that:

(1) The contradictory pairs, affirmative universal and negative particular on the one hand, negative universal and affirmative particular on the other, cannot both be true or false.

(2) The contraries, affirmative universal and negative universal may be false together, but not true.

(3) The subcontrary propositions, affirmative particular and negative particular, in contrast to the contraries, may be true together, but not false.

(4) As to subaltern proposition, it is necessarily true if its universal is true and the universal also must be false if it is false. However, neither that the particular is true guarantees the truth of the universal nor does that the universal is false warrant the falsity of the particular.

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72 Ibn Sīnā, *al-Ibāra*, p. 78.

Conclusion

The most effective Arabic logician of the middle ages, Avicenna, was a member of the tradition originating with Aristotle and formed by the controversies between the Peripatetics and the Stoics and he appears to benefit from this legacy, even though the sources of his theory of conditionals are hardly known to us. Nevertheless we find in his works some telling hints. His theory of conditionals involves significant reminiscences of those logicians who are familiar to the Peripatetic tradition, like Galen and Boethius, but we know historically that Boethius' works were not transmitted to the Arabic logicians. It is, however, pretty likely that Galen, Boethius and Avicenna were fostered by the same Greek sources that were most probably Peripatetic. Yet we have to point out that the gateway through which he reached to those sources was perhaps al-Fārābī, whose views on the logic of conditionals have not substantially arrived to us.

To view Avicenna's logic of conditionals merely as a sequel to that of the Stoics would be highly reductionist approach. It is unlikely that Avicenna read the works by the Stoics, because virtually none of them were translated into Arabic. It is therefore more reasonable to assume that he was informed about the Stoic views only via the Peripatetic commentaries and, in that school, the work of Alexander was particularly important to Avicenna. But, as we have seen above, his approach to those commentaries is rather critical; Avicenna only quotes these sources to criticize them. Thus, there is strong evidence to suggest that Avicenna's logic of conditionals is highly original. He moves the theory of conditional propositions forward such that we may only encounter very slight traces and anticipations of Avicenna's mature view in the work of his predecessors. Avicenna constantly avoids blindly imitating his predecessors—even al-Fārābī, corrects what he saw as erroneous and completes what he found to be defective in their views. In the case of the logic of conditionals, Avicenna's characteristically independent and self-confident personality is on full display.

In regards to the conditional propositions, the fundamental principle of Avicenna's scholarship is that the conditional must be treated in a parallelism with the predicative propositions. Accordingly he applies to the conditionals all properties and relations that have been ascribed to the predicatives since Aristotle, such as the quality, quantity, modality, and oppositional relations. Thus, he contributes new and productive aspects to

the logic of conditionals. Another tenet of Avicenna's theory is that he is not committed to the truth-functional approach. In his view, the truth of any conditional is not a function of the truth value of its parts. Rather it is contingent upon whether the relation of implication or conflict that the proposition refers holds or not. The last point served to differentiate Avicenna's theory from that of the Stoics.

Nevertheless, his system has, of course, some shortages and restrictions as well. For example it is not clear whether the consequent of separative-conditionals in particular is a complete proposition or an alternative predicate. The examples he uses suggest sometimes that we are faced with a predicative proposition that has two alternate predicates. Furthermore, Avicenna does not satisfactorily give an account of whether negative conditionals are still conditional.

Öz
İbn Sina'da Şartlı Önermelerin Karşıtı

Bu makale, İbn Sina'nın şartlı önermeler ve aralarındaki karşıt ilişkileri inceler. Aynı şekilde İbn Sina'nın Antik Yunan ve Arap kaynakları ile kendisinden sonra Arap Mantığı geleneğine etkisini araştırır. Yazı, İbn Sina'nın şart/koşul teorisinin eski mantıkçılardan ayrıldığı yönleri ile teorinin önemi ortaya koymayı dener. Ayrıca İbn Sina'nın teorisinin aslında Stoacı değil, Peripatetik olduğunu göstermeyi amaçlar.

Anahtar Kelimeler: İbni Sina, şartlı önermeler, karşıtlık ilişkisi

Abstract
Avicenna on the Opposition of Conditional Proposition

This paper examines Avicenna's remarks and considerations on conditional propositions and the oppositonal relations between them. It also tries to detect his ancient and Arabic sources and his influence on the tradition of Arabic logic after him. It aims to show that Avicenna's theory of conditionals has original aspects different from that of ancient logicians and that he improved this theory significantly. It also aims at showing that Avicenna's theory is essentially Peripatetic, not Stoic.

Keywords: Avicenna, conditional propositions, oppositonal relations

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