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The essential and the derivative moods of Aristotelian syllogism

Lei Ma[1]*

*Corresponding author: Lei Ma, Center for the Philosophy of Problem, Huaqiao University, Xiamen, China
E-mail: yuxuanma@hotmail.com

Abstract: It is generally accepted that it is a mistake that Aristotle ignore the moods of the fourth figure in his syllogism. In this paper, I shall argue the Aristotelian syllogism consisting of the essential moods and their derivative moods is complete or self-contained, all the moods of the fourth figure can be derived from the essential moods. The analysis table provided in the paper will contribute to showing the procedure from the essential moods to the derivative ones, and also showing the distinction between the Aristotelian and the traditional syllogism. The traditional syllogism strictly differentiate the major premise from the minor one in a syllogism, and strictly limit the major term and minor one in the premise or the conclusion of a syllogism, and thus some moods described by Aristotle are missing. I think the Aristotelian syllogism is more flexible and feature-rich than the traditional one. If a syllogism contains the negative nouns and the quantified predicates, the number and type of syllogism will be greatly expanded, and can't be described by the Aristotelian syllogism, let alone the traditional one.

Subjects: Logic - Philosophy; Introductory Logic; Philosophy of Logic

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1. The distinction between the traditional and the Aristotelian syllogism

It is well known that, in the history of logic, there are two different syllogisms, one was founded by Aristotle and has systematically been expounded in his *Prior Analytics*, another was first put forward

ABOUT THE AUTHOR

Lei Ma, a distinguished professor of Huqiao University, a Chair in the Center for the Philosophy of Problem at Huaqiao University. Before coming to Huaqiao University, he was a professor at Southeast University. His doctoral degree is from Wuhan University. His areas of competence are logic, philosophy of science, and philosophy of problem. He was a Visiting Scholar at the Department of Philosophy at the University of Michigan in 2009. His cooperative professor is Lawrence Sklar, whose book *Theory and Truth* was translated by him into Chinese, and published by the Science Press in 2014.

Lei Ma

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Most people have two wrong ideas about the Aristotelian syllogism, that is, first, the traditional syllogism is better than the Aristotelian syllogism, second, Aristotle ignores the moods of the fourth figure in his syllogism. Contrarily, I believe the opposite. I think the Aristotelian syllogism is more flexible and feature-rich than the traditional one. It is a virtue that there is only three moods in the Aristotelian syllogism, if we follow Aristotle's train of thought, we would find a better syllogism theory different from the traditional syllogism which contains four moods. The reason for this is that (1) the Aristotelian syllogism is self-contained, all the moods of the fourth figure can be derived from the essential moods, (2) if the negative nouns and the quantified predicates can be introduced by the Aristotelian syllogism, the number and type of syllogism will be greatly expanded.

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based on Aristotelian syllogism by the later ancient logicians, and became the systematized knowledge during the Middle Ages. The latter is called *the traditional syllogism*.

The division standard of the figures of the traditional and the Aristotelian syllogism is not the same. In the traditional syllogism, the figures are divided into four sorts according to the position of the middle term in the premises. In the first figure, the middle term is the subject of the major premise and the predicate of the minor; in the second figure, the middle term is the predicate of both premises; in the third figure, it is the subject of the two premises; in the forth figure, it is the predicate of the major premise and the subject of the minor premise. In their presentation, the major premise and the subject of the premise come first, and the minor premise and the predicate second.

In each figure of the traditional syllogism, there are different moods which are depended upon the quality and quantity of the propositions composing it. The letters *A*, *E*, *I*, *O* are used to denote the four kinds of propositions. For example, in the first figure, if the major premise, the minor premise, and the conclusion are all universal affirmative propositions, the mood AAA of the figure is formed; in the second figure, the mood *AEE* means that the major premise is a universal affirmative proposition and the minor premise and the conclusion is all universal negative propositions. If we leave out all question of validity, the letters *A*, *E*, *I*, *O* may be combined in threes to make 64 possible moods of each figure. Thus, four figures have 256 moods. But most of these mathematically possible moods, which sin against the rules of the syllogism, are soon seen to be invalid. For example, moods *EEA* and *IIO* must be discarded because they sin against the rules that no conclusion can be drawn from two negative or two particular premises. According to the general rules of the syllogism, we are left with eleven moods: *AAA, AAI, AEE, AEO, AII, AOO, EAE, EAO, EIO, IAI, OAO*.

Distributing these 11 moods to the 4 figures according to the special rules, we have the following 24 valid moods:

The first figure: *AAA, EAE, AII, EIO, (AAI), (EAO)*.
The second figure: *AEE, EAE, AOO, EIO, (AEO), (EAO)*.
The third figure: *AAI, EAO, AII, EIO, IAI, OAO*.
The fourth figure: *AAI, AEE, EAO, EIO, IAI, (AEO)*.

The moods with brackets are generally known as *the weakened moods* because they have a common feature, i.e. a particular conclusion is drawn from the two universal premises. The minor term of a weakened mood is distributed in the premise, but undistributed in the conclusion. The scope of the object is narrowed, so the mood seems weaker. The weakened moods seem to have been obtained by two inferential processes. Take the first case for example, first, obtaining the conclusion *A* from the two premises *AA*, we have *AAA*; then regarding the conclusion *A* as premise, we have the conclusion *I* by applying to the rule of immediate inference. Thus, the mood also appears to be weaker from the process of reasoning. From the perspective of modern logic, if the subject of a proposition is an empty class, it is illicit that we draw a particular or existential proposition from the universal proposition. Therefore, in the case that the subject is an empty class, the five weakened moods are invalid in the modern logic. The other 19 moods have no such "weakened" problems, they are all stronger moods.

If we divide the traditional syllogisms into 4 figures only according to the position of the middle term, then each figure as mentioned above have two kinds of moods, 4 figures have 8 kinds of moods, and from this the total number of the moods of traditional syllogisms should reach 520 (64 × 8). Moreover, the valid moods of the traditional syllogisms are far beyond the 24 types as commonly believed. Compared with the Aristotelian syllogism, the richness of the traditional syllogism which misses many possible valid moods is obviously insufficient.

Different from the traditional syllogism, the Aristotle syllogism has its special representations and classification standard. He attaches great importance to the role of middle term in the formation of the figures of syllogism, and fall the method of the formation into three categories. He says:

> So we must take something midway between the two, which will connect the predications, if we are to have a syllogism relating this to that. If then we must take something common in relation to both, and this is possible in three ways (either by predicating A of C, and C of B, or C of both, or both of C), and these are the figures of which we have spoken, it is clear that every syllogism must be made in one or other of these figures. The argument is the same if several middle terms should be necessary to establish the relation to B; for the figure will be the same whether there is one middle term or many. (Aristotle, 2014, Book I, pt. 23, 41a12–41a20)

The so-called Aristotelian figures of the syllogisms are distinguished by the different possible combinations of the three concepts in the premises. It gave some logicians the idea that some valid moods have been missed by Aristotle. Lukasiewicz says:

> It follows from these facts that Aristotle knows and accepts all the moods of the fourth figure. This must be emphasized against the opinion of some philosophers that he rejected these moods. Such a rejection would be a logical error which cannot be imputed to Aristotle. His only mistake is the omission of these moods in the systematic division of the syllogisms. We do not know why he did so. (Lukasiewicz, 1957, p. 27)

I do not think it is a mistake that Aristotle omits the moods of the fourth figures in the traditional syllogism. In Aristotle's expression of a syllogism, the predicate of a proposition always appears in front of the subject of the proposition. This does not effect the formation of the figures. The order of the major and minor premises of Aristotle's syllogism, however, is not fixed, since the two premises can be interchanged, i.e. there is no difference between "A should be asserted of C, and C of B" and "C should be asserted of B, and A of C." This character effects the formation of the figures, that is, if we do not consider the order of the premises of a syllogism, the position of the middle term has only three possible cases, which leads to three kinds of figures.

In the first figure, the middle term is the subject of one premise and the predicate of the other. In the second figure (the middle figure), the middle is the predicate of the both premises. In the third figure (the last figure), the middle is the subject of the both premises.

Clearly, the first figure of Aristotle's syllogism in fact contains the fourth figure of the traditional syllogism. According to the standard of Aristotle, each essential mood and its derivative mood are "the same syllogism." In my opinion, the logic system of Aristotle's syllogism is complete or self-contained, because all valid moods in the traditional syllogism can be found in Aristotle's syllogism. Furthermore, it is more likely to develop the theory of syllogism according to the Aristotelian syllogism.

2. How is the derivative moods deduced from the essential moods?

Lukasiewicz thinks that it is not important to recognize that the moods of the first figure of Aristotle's syllogism is regard as perfect syllogisms, or Barbara and Celarent can be taken as axioms of Aristotle's syllogism. He says:

> Aristotle accepts as perfect syllogisms the moods of the first figure, called Barbara, Celarent, Darii, and Ferio. Yet in the last chapter of his systematic exposition he reduces the third and fourth moods to the first two, and takes therefore as axioms of his theory the most clearly evident syllogisms, Barbara and Celarent. This detail is of no little interest. Modern formal logic tends to reduce the number of axioms in a deductive theory to a minimum, and this is a tendency which has its first exponent in Aristotle. (Lukasiewicz, 1957, pp. 44–45)

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What we discuss here is the normal or essential moods of Aristotle's syllogism, which actually consists of two parts, namely, the essential moods and their derivative ones. To understand the problem can help us to recognize that Aristotle does not leave out any valid moods in his system. How many kinds of moods contain in the three figures of Aristotle's syllogism? Look at Aristotle's discussion:

> Since we understand the subjects with which syllogisms are concerned, what sort of conclusion is established in each figure … The universal affirmative is proved by means of the first figure only and by this in only one mood; the universal negative is proved both through the first figure and through the second, through the first in one mood, through the second in two. The particular affirmative is proved through the first and through the last figure, in one mood through the first, in three moods through the last. The particular negative is proved in all the figures, but once in the first, in two moods in the second, in three moods in the third. (Aristotle, 2014, Book I, pt. 26, pp. 42b27–42b40)

> It addresses 14 moods (see the note by Chen, 1990, p. 74):
> The first figure: *Barbara, Celarent, Darii, Ferio.*
> The middle figure: *Camestres, Cesare, Festino, Baroco.*
> The final figure: *Darapti, Disamis, Datisi, Felapton, Ferison, Bocardo.*

According to Aristotle's argument, some logicians believe these moods constitute the normal or essential moods of Aristotle's syllogism[1], because they think other valid moods of Aristotle's syllogism can be demonstrated by means of these moods. For simplicity, I made an analysis Table 1. The analysis Table 1 maintains the four figures of the traditional syllogism to make it easy to compare with the three figures of the Aristotle's syllogism. Regarding tentatively the 14 moods as the essential ones, I denote the essential moods by the serial number ① with the indication of their proper nouns (if such exist) in Table 1. For instance, *AAA*① means that the *AAA* mood of the first figure is the essential one, and Barbara as its proper nouns is also indicated in Table 1. In Table 1, the structure of each mood is marked in accordance with the sequence of the premise, the minor premise and the conclusion. For instance, the constitutional relation of the *AAA* mood of the first figure is expressed by *MAP-SAM-SAP*. The logical form obtained from interchanging *S* and *P* of one form is not regard as a new logical one. For example, *MES∧PAM→SOP* and *MEP∧SAM→POS* is seen as the same form.

The moods obtained from the essential moods by certain logical rules might be called *derivative moods* which include three types:

The first type of derivative moods is generally referred to as weaker moods, which are obtained by inferring the particular conclusion of a new syllogism from the conclusion of the original syllogism which can be essential or derivative mood. They are so called because the subject range of the conclusion of the new moods has been narrowed. Here, a weaker mood is no longer denoted by a parentheses as the traditional logic does, but by ②. For example, the *AAI* mood of the first figure is a weaker one, which is denoted by *AAI*② and indicated with *Barbara'* which means a weaker mood obtained from Barbara. The weaker mood and its original one cannot validly derived from one another, that is, the weaker can be derived from the original, but not vice versa. For example, *AAI*② can be obtained from *AAA*① which cannot be obtained from *AAI*②.

The second type of derivative moods is obtained from interchanging the subject and the predicate of the conclusion of a syllogism. We might as well call the new syllogism inverse mood, since the positions of the subject and predicate have been interchanged, and judgment object of the conclusion of the new syllogism has been changed. The inverse mood is denoted by ③. For instance, in the first figure, the inverse mood of *AAA*① (i.e. *Barbara*) is *AAI*, which is denoted by *AAI*③. Besides, *AAI*

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Table 1. The analysis of essential and derivative moods of syllogisms			
First figure	**Second figure**	**Third figure**	**Fourth figure**
AAA①			*AAA④¹*
MAP-SAM-SAP			*SAM-MAP-SAP*
Barbara			*PAM-MAS-PAS*
			Barbara˘
AAI②		*AAI①*	*AAI④¹*
MAP-SAM-SIP		*MAP-MAS-SIP*	*SAM-MAP-PIS*
Barbara'		*Darapti*	*PAM-MAS-SIP*
AAI③		*AAI③④¹*	*Barbara˘˘*
MAP-SAM-PIS		*MAP-MAS-PIS*	*Baralipton˘*
Barbara˘		*MAS-MAP-SIP*	*Bramantip*
Baralipton		*Darapti˘*	*AAI②④¹*
		Darapti˘	*SAM-MAP-SIP*
			PAM-MAS-PIS
			Barbara˘'
			Barbara'˘
	AEE①		*AEE④1④²*
	PAM-SEM-SEP		*SAM-MEP-PES*
	Camestres		*PAM-MES-SEP*
	AEE③④¹		*Celantes˘*
	PAM-SEM-PES		*Celarent˘˘*
	SAM-PEM-SEP		*Camestres ^ ²*
	Camestres˘		*Camenes*
	Cesare˘		*AEE④¹④²*
			SAM-MEP-SEP
			PAM-MES-PES
			Celarent˘
			Camestres˘ ^ ²
			Cesare˘ ^ ²
AEO④²	*AEO②*	*AEO④¹*	*AEO②④²*
MAS-PEM-SOP	*PAM-SEM-SOP*	*MAS-MEP-SOP*	*PAM-MES-SOP*
MAP-SEM-POS	*Camestres'*	*MAP-MES-POS*	*Celantes˘'*
Felapton˘ ^ ²	*AEO②*	*Felapton˘*	*Celarent˘˘'*
Fapesmo	*PAM-SEM-POS*		*Camestres ^ ²'*
	Camestres˘'		*Camenes'*
	Cesare˘'		*Camestres' ^ ²*
			AEO②④¹④²
			SAM-MEP-SOP
			PAM-MES-POS
			Celarent˘'
			Camestres˘ ^ ²'
			Cesare˘ ^ ²'
			Celarent'˘
			Camestres˘' ^ ²
			Cesare˘' ^ ²

(Continued)

Table 1. (*Continued*)			
First figure	**Second figure**	**Third figure**	**Fourth figure**
EAE①	EAE①④²		
MEP-SAM-SEP	PEM-SAM-SEP		
Celarent	Cesare		
EAE③	Celarent ^ ²		
MEP-SAM-PES	EAE③④¹④²		
Celarent˘	PEM-SAM-PES		
Celantes	SEM-PAM-SEP		
	Cesare˘		
	Celarent ^ ²˘		
	Camestres˘		
	Celarent˘ ^ ²		
	Celantes ^ ²		
EAO②	EAO②④²	EAO①	EAO④¹④²
MEP-SAM-SOP	PEM-SAM-SOP	MEP-MAS-SOP	SEM-MAP-POS
Celarent'	Cesare'	Felapton	PEM-MAS-SOP
EAO②	Celarent' ^ ²		Fapesmo˘
MEP-SAM-POS	EAO②④²		Felapton ^ ²
Celarent˘'	PEM-SAM-POS		Fesapo
Celantes'	Cesare˘'		
	Camestres˘'		
	Celarent˘' ^ ²		
	Celantes' ^ ²		
AII①		AII①④²	
MAP-SIM-SIP		MAP-MIS-SIP	
Darii		Darii ^ ¹	
AII③		Datisi	
MAP-SIM-PIS		AII③④¹④²	
Darii˘		MAP-MIS-PIS	
Dabitis		MAS-MIP-SIP	
		Datisi˘	
		Disamis˘	
		Darii˘ ^ ¹	
		Dabitis ^ ¹	
		IAI①	IAI④¹④²
		MIP-MAS-SIP	SIM-MAP-PIS
		Disamis	PIM-MAS-SIP
		IAI③④¹	Dabitis˘
		MIP-MAS-PIS	Disamis ^ ¹
		MIS-MAP-SIP	Dimaris
		Disamis˘	IAI④¹④²
		Datisi˘	SIM-MAP-SIP
			PIM-MAS-PIS
			Darii˘
			Disamis˘ ^ ¹

(*Continued*)

Table 1. (*Continued*)			
First figure	**Second figure**	**Third figure**	**Fourth figure**
			Datisi˘ ^ 1
EIO①	*EIO①④²*	*EIO①④²*	*EIO④¹④²*
MEP-SIM-SOP	*PEM-SIM-SOP*	*MEP-MIS-SOP*	*SEM-MIP-POS*
Ferio	*Ferio ^ 2*	*Ferio ^ 1*	*PEM-MIS-SOP*
	Festino	*Ferison*	*Frisesomorum˘*
			Ferio ^ 21
			Festino ^ 2
			Ferio ^ 12
			Ferison ^ 2
			Fresison
IEO④²	*IEO④¹*	*IEO④¹*	*IEO④¹*
MIS-PEM-SOP	*SIM-PEM-SOP*	*MIS-MEP-SOP*	*SIM-MEP-SOP*
MIP-SEM-POS	*PIM-SEM-POS*	*MIP-MES-POS*	*PIM-MES-POS*
Ferison˘ ^ 2	*Festino˘*	*Ferison˘*	*Ferio˘*
Festino˘ ^ 1			
Frisesomorum			
	AOO①	*AOO④¹*	
	PAM-SOM-SOP	*MAS-MOP-SOP*	
	Baroco	*MAP-MOS-POS*	
		Bocardo˘	
	OAO④¹	*OAO①*	
	SOM-PAM-SOP	*MOP-MAS-SOP*	
	SOM-PAM-SOP	*Bocardo*	
	Baroco˘		

is marked with *Barbara˘* which means it is obtained from Barbara, and which is known as *Baralipton*. The proper nouns of other non-essential moods (if have) are also marked in Table 1. An inverse mood and its original mood do not necessarily have a mutual inference relationship, that is, all inverse moods can be obtained from their original moods, but some of the original moods can be obtained from the inverse moods, and some cannot. For example, *EAE③* can be obtained from *EAE①*, and *EAE①* can also be obtained from *EAE③*; *AAI③* can be obtained from *AAA①*, but *AAA①* cannot be obtained from *AAI③*.

The third type of derivative moods are obtained from equivalent transformation of the premises, which means the process of interchanging the positions of the major and minor premises of a syllogism, or of interchanging the subject and predicate of one of the two premises, while retaining their meaning. This type of moods has a common feature, i.e. the change of the premises has no effect on the conclusion, whose judgment object and its scope will not be changed accordingly. It seemed to Aristotle, of course, that there is no distinction between so-called major and minor premises since the two premises have equal status. However, the syllogism obtained from changing the premises of a syllogism is still regarded as a new one, because the position of the middle term which determine the structure of a syllogism is determined by the order of the two premises and the order of the subject and predicate of a premise. The syllogism so formed can be called *counterpart mood*, because a mood and its original mood has a perfect symmetry relationship, which means the two moods can equivalently be obtained from one another. I use ④ to mark the counterpart moods.

I divide the counterpart moods into two types. One is obtained from the transposition of the two premises of a syllogism. I call this type of moods *major counterpart moods*, which is denoted by ④^1. For instance, the counterpart of *AAA* mood of the first figure is *AAA*④^1 mood of the third figure. *Barbara*˘ are used to indicate that it is obtained, by interchanging the premises, from *Barbara* of the first figure. If the structure relationship of *AAA*① of the first figure is indicated by *MAP-SAM-SAP*, the structure of its counterpart *AAA*④^1 will be *SAM-MAP-SAP*, from which *PAM-MAS-PAS* can be obtained from interchanging *S* and *P*. The two structures are equivalent. Seemingly, the judgment object of the conclusion has been changed from *S* to *P*, but since we know Aristotle thinks that different symbols can express the same content, we know that, in this example, *S* and *P* in different structures actually represent the same object. For comparison, this two kinds of annotation methods are shown in Table 1. Sometimes a mood may have several sources, e.g. it is both the inverse and the counterpart mood of a mood. This situation is marked together in Table 1, for example, *AAI*③④^1 means *AAI* is both the inverse mood and the counterpart mood of a mood. For further information, from *Darapti*˘ we know that *AAI* is the converse mood of *Darapti*, and from *Darapti*˘ we know that *AAI* is the major counterpart mood of *Darapti*.

Another type is called *minor counterpart mood*, which is obtained from the transposition of the subject and predicate of a premise, and which is denoted by ④^2. For instance, *AEO*④^2 is obtained from interchanging the subject and predicate of the minor premise of *AEO*④^1. The minor counterpart moods are divided into two cases, one of which is denoted by ∧^{1}, and which is obtained from equivalently interchanging the subject and predicate of a particular affirmative proposition. For instance, *Darii* ∧^{1}, which has the proper noun *Datisi*, is obtained from equivalently interchanging the subject and predicate of the particular affirmative proposition in *Darii*. Again, *Datisi*˘∧^{1} is obtained from equivalently interchanging the subject and predicate of the particular affirmative proposition in *Datisi*˘. Another case is denoted by ∧^{2}, which means it is obtained from equivalently interchanging the subject and predicate of a universal negative proposition. Take *Felapton*˘∧^{2} for example, it is obtained from equivalently interchanging the subject and predicate of the universal negative proposition in *Felapton*˘. There is the proper noun *Fapesmo* which can be used to stand for *Felapton*˘∧^{2}.

Each space in Table 1 is used to represent a same mood of syllogism on the same row is excluded from the figure represented by its corresponding column. As can be seen from Table 1, the essential moods of Aristotle's syllogism are 14, and the derivative moods are 48 (This result has been revealed by a few logicians, but they cannot give us a clear explication of the logical relationship between the essential and the derivative moods of Aristotle's syllogistic. See Chen, 1990, p. 79), which are as follows:

The first figure: *MAP-SAM*-SIP, *MAP-SAM-PIS*, *MAS-PEM-SOP*, *MAP-SEM-POS*, *MEP-SAM-PES*, *MEP-SAM-SOP, MAP-SIM-PIS*, *MEP-SAM-POS*, *MIS-PEM-SOP*, *MIP-SEM-POS*.

The middle figure: PAM-*SEM-PES*, *SAM-PEM-SEP*, PAM-*SEM*-S0P, PAM-*SEM-POS*, *PEM-SAM-PES*, *SEM-PAM-SEP*, *PEM-SAM-SOP*, *PEM-SAM-POS*, *SIM-PEM-SOP*, *PIM-SEM-POS*, *SOM-PAM-SOP*, *SOM-PAM-SOP*.

The final figure: *MAP-MAS-PIS*, *MAS-MAP*-SIP, *MAS-MEP-SOP*, *MAP-MES-POS*, *MAP-MIS-PIS*, *MAS-MIP*-SIP, *MIP-MAS-PIS*, *MIS-MAP*-SIP, *MIS-MEP-SOP*, *MIP-MES-POS*, *MAS-MOP-SOP*, *MAP-MOS-POS*.

3. The possible extended moods beyond the Aristotelian syllogism

The derivative moods of Aristotle's syllogism do not include the case where a negative term or a contradictory judgment is introduced, let along the case where the predicate of a proposition is quantified. Otherwise, the syllogism will be extremely complex. For example, if the negative terms are introduced as variables, the following moods of the syllogism, through the method of obversion[2] or of variable substitution, can be derived from *Barbara*:

EAA: *ME(¬P) –SAM–SAP*
EAE: *ME (¬P) –SAM–SE (¬P)*
EEA: *ME (¬P) –SE (¬M) –SAP*
EEE: *ME (¬P) –SE (¬M) –SE (¬P)*
AAE: *MAP–SAM–SE (¬P)*
AEA: *MAP–SE (¬M) –SAP*
   (¬M) *AP–SEM–SAP*
AEE: *MAP–SE (¬M) –SE (¬P)*
AAA: *MAP– (¬S) AM– (¬S) AP*

It is not hard to see, if ¬*P* in above-mentioned *EAE* is replaced with *P*, Celarent shown as the *EAE*① mood of the first figure, can also be obtained.

If the contradictory of a proposition is introduced into the syllogism, the following moods, using the rule of Square of Opposition, can be obtained from Barbara:

(¬*O*) *AA* : ¬ *(MOP)–SAM–SAP*
(¬*O*) (¬*O*) *A*:¬ *(MOP)–* ¬ *(SOM)–SAP*
(¬*O*) *A* (¬*O*) : ¬ *(MOP)–SAM–* ¬ *(SOP)*
(¬*O*) (¬*O*) (¬*O*) : ¬ *(MOP)–* ¬ *(SOM)–* ¬ *(SOP)*
A (¬*O*) (¬*O*) :*MAP–* ¬ *(SOM)–* ¬ *(SOP)*
AA (¬*O*) :*MAP–SAM–* ¬ *(SOP)*
A (¬*O*) *A* : *MAP–* ¬ *(SOM)–SAP*[3]

If the case where the predicates of three propositions have been quantified, and where, for example, *SAP* is used to indicate that the predicate *P* is universal, and *SA [P]* particular, the following syllogisms shall be obtained from *Barbara*:

AAA: *MAP–SA[M]–SAP*
AAA: *MAP–SAM–SA[P]*
AAA: *MAP–SA[M]–SA[P]*
AAA: *MA[P]–SAM–SAP*
AAA: *MA[P]–SA[M]–SAP*
AAA: *MA[P]–SAM–SA[P]*
AAA: *MA[P]–SA[M]–SA[P]*

In practical thinking, the predicate of quality judgments often be quantified, but the logical description of this thinking phenomenon is usually ignored. I think it is significant to quantify the predicates of all quality judgments. A few definitions on the quantification of the premises are given by Aristotle:

> A premiss then is a sentence affirming or denying one thing of another. This is either universal or particular or indefinite. By universal I mean the statement that something belongs to all or none of something else; by particular that it belongs to some or not to some or not to all; by indefinite that it does or does not belong, without any mark to show whether it is universal or particular, e.g. "contraries are subjects of the same science", or "pleasure is not good". (Aristotle, 2014, pt. 1, 24a17–24a20)

Aristotle does not give a definition of singular proposition, and, on most occasions, conceives an uncertainty premise as equal to a particular premise. Therefore, the universal and particular propositions play a crucial role to Aristotle' quantification theory. Aristotle, however, only considers to quantify the subject, not to the predicate. This can also be regarded as one of the limitations of Aristotle's

syllogism. Of course, it is not easy to develop Aristotle's system by quantifying the predicates. William Hamilton of Edinburgh attempted to improve Aristotle's system by quantified predicates, but on the whole, he was not successful, although he achieved some successes (see Kneale & Kneale, 1995, pp. 452–454).

It should be noted that the extended moods are neither Aristotle's syllogism, nor the traditional syllogism. But this is not to say that we should not give syllogism or moods of syllogism a new broader definition. The traditional syllogism increases the fourth figure, but distinguishes sharply between the major and minor premises, limits severely the major and minor terms. As a result, some moods of figures described by Aristotle are missing in the traditional syllogism. Aristotle's major and minor terms are determined by the middle term, namely, the major term is the term which contains the middle term, and the minor term is the term which belongs to the middle term. This indicates that the major and minor terms are independent of the conclusion in the Aristotle's syllogism. Thus, compared to the traditional syllogism, a rich variety of structure forms of the conclusion can be seen in the Aristotle's syllogism. We know that the form structure of a traditional syllogism is restricted by the major and minor terms, which are determined by the conclusion, namely, the predicate of the conclusion is the major term in the premise, and the subject of the conclusion is the minor term in the premise. Accordingly, different figures and their moods are generated. If the propositions which constitute the premises and the conclusion of a syllogism cannot only be the quality proposition, but also be the contradictory of a quality proposition, if the terms which constitute the premises and the conclusion of a syllogism cannot only be major term, minor term and middle term, but also be their negative terms, then the types of the form structure of syllogism will be richer far beyond the Aristotle's syllogism, let along the traditional syllogism. Moreover, the introduction of negative terms will make some rules of the traditional syllogism fail. I assume that these new forms of structure can be proved by the essential figures and their moods described by Aristotle. Due to the large number of these forms, they are not described in Table 1.

Author details
Lei Ma[1]
E-mail: yuxuanma@hotmail.com
ORCID ID: http://orcid.org/0000-0003-2860-3471
[1] Center for the Philosophy of Problem, Huaqiao University, Xiamen, China.

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Notes
1. The argument of normal moods originates from Shaokui Mo and Jialong Zhang, See Zhang, 1988. The argument of essential moods comes from Zhongtang Chen. See Chen, 1990, pp. 73–74; Modern logic and traditional logic

2. Some people think that Aristotle did not endorse observation, but what we discuss here is how to extend moods beyond the traditional and Aristotelian syllogism, so the method of observation can be considered.
3. The distinction between, e.g. ᒣ (*SAP*) and ᒣ ((ᒣ *S*)*AP*), ᒣ (*SOP*)an ᒣ ((ᒣ *S*)*OP*) should be noticed in the symbolic expression In the two sets of propositional form, the former means "Not all S are P" and "Not all non S is P", the latter means "Not some S is not P" and "Not all non S is not P" In order to avoid the confusion, I add a bracket outside each negative noun which is the subject of a proposition, because "ᒣ" are used to express both the negation of a proposition, and the negation of a term, while the kinds of negation may appear in front of the subject.

References
Aristotle. (2014). *Prior analytics*. (A. J. Jenkinson trans.). Retrieved from http://etext.library.adelaide.edu.au/a/ aristotle/
Chen, Z. (1990). *The modern logic and traditional logic*. Guangzhou: Jinan University Press.
Kneale, W., & Kneale, M. (1995). *The development of logic*. (J. Zhang & H. Hong). Beijing: The Commerce Press.
Lukasiewicz, J. (1957). *Aristotle's syllogistic: From the standpoint of modern formal logic* (2nd ed.). Oxford: The Clarendon Press.
Zhang, J. (1988). To understand Aristotle's syllogism from the perspective of modern logic. *The Philosophy Research, 5*, 39–46.

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