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# Aristotle's ategorical Syllogisms as Dialectical Games

## Work in Progress

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### Introduction

Since the publications of Kurt Ebbinghaus (1964), John Corcoran (1972, 1974b) and Robin Smith (1984; 1986, 1989), we learned that Aristotle's theory of categorical syllogism should be understood as a system of rules by the means of which a system of logic is declined. This new perspective contrasts – and rightly so - with the axiomatic approach initiated by the work of Jan Lukasiewicz (1957). Recent work by Mathieu Marion and Helge Rückert (2015) shows that the notion of quantifier assumed in the *Analytica* has its roots in the *Topica* and more generally it looks as if the dialectical games of the *Topica* are intimately related to the notion of quantifiers deployed in the theory of syllogism. It is our main claim, that, though we agree with the insight that the theory of syllogism should be understood as a system of rules, these rules in fact can be seen as determining some specific dialectic games that extend the games of the *Topica* with inferential moves. Moreover, it is our view that a dialectical understanding of the theory of syllogism provides a uniform frame that links the *Topica* and the *Analytica* – despite Sir David Ross's (1949, p. 59) stern dismissal of the *Topics*. In fact, our interpretation follows the path pointed out by Marion/Rückert (2015), that starts with Christian August Brandis (1833), and continues with Ernst Kapp (1942), and Kurt von Fritz (1984), where the priority of *Topics* is reaffirmed, and *Prior Analytics* is understood in terms of its dialectical setting. In France, Brunschwig (1967) and recent work by Michel Crubellier (2008, 2011, 2014) and Crubellier and André Laks (2009a, b), also point in the same direction. Moreover, there are many commentators, ranging from, say, Le Blond (1939) to G. E. L. Owen's (1986) and Irwin (1999), that have argued in favour of the methodological importance of dialectic for Aristotle's philosophy as a whole. However, with the sole exception of the work of Marion and alii the precise description of the games have not been yet developed and neither has been yet shown how to develop the theory of syllogism within a dialectical setting. The latter is the main aim of the present study.

As mentioned above we read the methods of proof deployed in the *Analytica Priora* as extending the use of dialectical games of the *Topica*– based on the presentation of counterexamples and indirect demonstration – to games that include “inferential moves”, that is, moves that force the player who endorses the premises of a perfect syllogism, to bring also forward the suitable conclusion. The precise link between the dialectical games of the *Topica* and those that structure the indirect and direct proofs of the *Analytica Priora* is what Mathieu

Marion and Helge Rückert call the *Socratic-Rule* of the *Topica* (a notion that is very close to the so-called *formal rule* in contemporary dialogical logic). Besides, we claim that the Socratic-Rule links the *Topica* and the *Analytica* not only through the notion of quantifier but also through the qualification of the different roles of the players. Indeed, the distinction of the roles of two players responds two pairs of roles, namely: (i) the identification of the player whose moves are restricted by the Socratic rule and the one whose moves are not, (ii) the further distinction of a player whose thesis (theses) are to be tested (Proponent) and an antagonist who triggers the test (Opponent). The interplay between both of these pairs follows from the challenge of a contradiction. Notice that a purely game theoretic way to characterize a contradiction amount identifying a contradiction as a pair of the posits of, say, player **X** against which the adversary **Y** wins even when **Y**'s own moves are restricted by the Socratic Rule: in order to win the adversary needs only to make himself use of the positive member of the pair, posited before by **X**, and challenge with it the negative member of the contradiction. Now, since in the *Topica* the main objective is to try to find a contradiction between **P**'s assertions it is the moves of **O** that will be restricted by the Socratic-Rule. In contrast, the use of indirect proofs in the *Analytica*, is to allow **P** to prove that the conclusion at stake follows from some contradiction between **O**'s posits. Thus, in the *Analytica*, it is **P**'s rather than **O**'s moves that are restricted by the Socratic-Rule. In other words, the identification of the player whose moves are restricted by the Socratic-Rule is dependent upon the identification of the player who challenges contradictions of his adversary under the terms established by this rule and in the context of the general aims of the game.

A not negligible point of our overall strategy is to stress the dialectical assumptions in the rule interpretation of Corcoran and Smith. As a matter of fact, in order to link the natural deduction interpretation with Aristotle's own style of demonstration Corcoran and Smith (following Corcoran) introduce operators such as "acceptance" and "But you have already accepted". These operators that are alien to the natural deduction framework and that stem from a dialectical terminology express, as we will show in the following section; applications of the Socratic rule. Furthermore our perspective integrates quite naturally the indirect demonstration; the proof by *ekthesis* and the rejection strategy (that Smith associates with the construction of countermodels). More generally we claim that our approach explains Corcoran's worries about the apparent lack of interest of Aristotle for a type of semantics that we nowadays call, model theoretic. Indeed, the point is that the overall theory of meaning of Aristotle's Logic has deep game theoretical roots.

Let us address now an unavoidable issue that concerns most of the work on history of logic. Does it nowadays make sense to study the work of Aristotle in the context of the level of sophistication reached by the contemporary developments in logic? The answer is double, on one hand contemporary researches stress the dialectical aspects of logic and on the other recent studies of reasoning in natural language come back to the syllogistic form of deduction. Let us discuss briefly both points:

- (i) As remarked by Clerbout/Rahman (2015) a brief examination on the most recent literature in logic will make it apparent that a host of research in this area is devoted to the study of the interface between games, logic and epistemology. These studies provide the

basis of ongoing enquiries in the history and philosophy of logic, going from the Indian, the Greek, the Arabic, the Obligations of the Middle Ages to the most contemporary developments in the fields of theoretical computer science, computational linguistics, artificial intelligence, social sciences and legal reasoning. In fact, a *dynamic turn*, as Johan van Benthem puts it, or more precisely a *dialectical* one is taking place where the epistemic aspects of inference are linked with game theoretical approaches to meaning where interaction play the central role.<sup>1</sup> In regard to the birth of this *contemporary* turn, it could be placed around the 1960's when Paul Lorenzen and Kuno Lorenz developed dialogical logic --- inspired by Wittgenstein's language games and mathematical game theory --- and when some time later on Jaakko Hintikka combined game-theoretical semantics with epistemic (modal) logic. If we were to pinpoint a precise date, the very beginnings of the dynamic turn could be situated in 1958, with Lorenzen's talk<sup>2</sup> "Logik und Agon". More generally the dialectical approach is at the heart of the impressive programme of *Pragmatist Inferentialism* of Robert Brandom [1994,2000], according to whom it is the chain of commitments and entitlements in a game of giving and asking for reasons that deploys conceptual content by tightening up knowledge and inference:

*A community precluded from giving reasons for beliefs cannot so much as have the concept of reliability—nor, accordingly (by anyone's lights), of knowledge. Its members can serve as measuring instruments—that is, reliable indicators—both of perceptible environing states and of one another's responses. But they cannot treat themselves or one another as doing that. For they do not discriminate between reliable indication and unreliable indication.* Brandom (2000, p. 107).

Moreover, according to Brandom, games of asking for reasons and giving them constitute the base of any linguistic practice:

*Sentences are expressions whose unembedded utterance performs a speech act such as making a claim, asking a question, or giving a command. Without expressions of this category, there can be no speech acts of any kind, and hence no specifically linguistic practice.* Brandom (2000, p.125).

Nonetheless, it is evident that the contemporary so-called *dialectical* turn has its roots in ancient Greece, where the agora emerged as the first public space for discussion and decision-making on diverse and serious matters, and where after the crucial influence of

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<sup>1</sup> New results in linear logic by J.-Y. Girard at the interfaces between mathematical game theory and proof theory on the one hand and between argumentation theory and logic on the other resulted in the work of, among others, S. Abramsky, J. van Benthem, A. Blass, H. van Ditmarsch, D. Gabbay, M. Hyland, W. Hodges, G. Japaridze, E. Krabbe, H. Prakken, G. Sandu, D. Walton and J. Woods, who placed game semantics at the center of a new concept of logic in which logic is understood as a dynamic instrument of inference. In this context see also Blass[1992], Abramsky & Mellies[1999], Girard[1999], Lecomte & Quatrini[2010,2011], Lecomte[2011], Lecomte & Tronçon[2011]. .

<sup>2</sup> Published as Lorenzen[1960].

the Sophists, of Plato and of Aristotle dialectical reasoning won a place in our understanding of science and constitution of a society which it ever lost any more.

(ii) In contemporary logic inferences are characterized from two main viewpoints the model-theoretic and the proof-theoretic one. By contrast most approaches to theory of inferences in natural language are of the model-theoretic kind. Koji Mineshima, Mitsuhiro Okada, and Ryo Takemura (2012) worked on a proof-theoretical approach to syllogistic reasoning that should provide an appealing and cognitively speaking efficient system to such kind of deductions carried out in natural language and that are close to those of diagrammatic reasoning.

It is our view, that Aristotle's work represent the interface between these two moments, the dialectical and the natural language one, and thus, beyond the obvious historical interest of studying its writings, we do think that a better understanding of his thought on these issues, despite the fact that it was developed in the gone golden era of Ancient Greece, will help us to render a fresh approach the notion of meaning as interaction, present in so many contemporary philosophical programs.

