Alternative Logics and Natural Inference

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ALTERNATIVE LOGICS AND NATURAL INFERENCE

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I. INTRODUCTION

Is logic normative for natural inference? This is the question that will turn up on more than few occasions throughout this paper. It is quite hard to answer because of opposing intuitions about how to approach the issue of *correctness* of natural inference. Reasoning is a process that is a vital part of our everyday lives as it helps us form true beliefs about the world, or rather, even interact better with it. It plays a crucial role in how we make our choices and how we rationalize ones that we have already made. But how to determine which kinds of inferential processes make us successful in the endeavour of adopting true beliefs or interacting with the world in any way? Is classical logic a good candidate for the norm-providing system?

So the answers to the first question vary. For instance, (1) one could say – 'Yes' , classical logic provides a norm for natural inference and anyone who fails to abide by it is simply wrong. However, as we will see, the classical account of logic has some unattainable standards that no actual or potential subject could live up to. Another answer might be (2) 'Yes', logic is normative for thought, but we will have to revise the standards of the classical account on the basis of being unattainable. But then another the questions poses itself – how exactly to adapt the classical account so that it become attainable for reasoning subjects? The final answer that one can happen upon when examining this discussion is (3) No, logic has absolutely nothing to do with natural inference. They are two completely separate phenomena and trying to find a common ground for them is a fool's errand.

Firstly, we need to get some historical background which might help us answer the question, after which we will turn to the contemporary discourse and see what exactly has changed from the moment when the question was first introduced.

After that we will turn to the techincal concerns of this discussion to assess if the systems of logic and natural inference are, in fact, commensurable.

I will look into the structure of both formal and informal arguments to determine what properties of inference can be viewed exclusively through the lens of logic and which are in need of some extra-logical support. I will also address some of the alternative accounts of logic which can help bring about several vital issues for the discussion, such as the problem of logical monism and pluralism and the theoretical commitments that they entail once accepted as correct.

Finally, I will attempt to propose an account that will, in my view, provide a bridge between the systems of natural inference and logic, in order to show in which way logic can be considered normative for reasoning.

II. THE STUDY OF LOGIC AND NATURAL INFERENCE

2.1 THE CONTEXT OF THE MILLENNIAL DISPUTE

Historically speaking, the relationship between natural inference and formal logic has been indeed very problematic, as the conceptions of both have been changing drastically over the course of the last 2500 years. If not the first, then most certainly the most important systematic consideration of the two in the context of the ancient Greece dates back to Aristotle's conceptions of dialektikê and logikê. As Duncombe and Novaes (2015) have rightly argued, the former could easily be seen as a prototype for the contemporary conception of a rational multi-agent debate, while the latter can be arguably seen as a conceptual basis for the contemporary account of classical mono-agent logic. Keeping this in mind, there are still relevant discrepancies between the Aristotle's account of the two concepts and the contemporary understanding of dialectic and logic which ought to be addressed. But to establish the relevant distinctions in the discourse between the two eras, it would be quite important to revise them separately. To avoid any possible further confusion, when I address the Aristotelian accounts of logic and dialectic, I will use the original terms logikê and dialektikê.

Starting with Aristotle's conception, let us turn to logikê first. At its very inception was the idea that we can competently discern the 'good' arguments from the ones that are not. As he understood it, it was vital for every rational being to be able to do so. And by launching into the debate of assessing arguments by a certain universal standard, we will primarily need to shift our focus onto the colossal chapter on logical consequence. In order to explicitly address his contribution to the vast domain of understanding the concept of sequitur, we need to introduce the dichotomy that made it possible for him to develop a system which would be

calibrated to do so; the dichotomy of concept words and the logic words (Corcoran, 1972). Concept words are, quite clearly, ones that bare semantic meaning (designated inside a natural language), while the logic words are the ones that establish logical relations between the concept words. Aristotle, quite ingeniously for his era, has noticed that it is not the properties of the concept words that grant us the certainty that the conclusion of the argument follows from its premises. It was the very structure of the sentence, which was defined by the logical terms. It became aparrent to him that if one were to extract all of the concept words from an argument and feed the empty slots with literally any other concept tokens, the conclusion would still follow from the premises just the same. This realization has become the foundation of the Aristotelian system of logic.

This Aristotelian notion of sequitur, i.e. the necessity of conclusion following from the premises regardless of the semantics of the content words was the very cornerstone of establishing the concept of argument validity (in its broadest sense). In terms of this approach, hence, we can say that an argument is valid if the conclusion necessarily follows from the premises by the virtue of its form. However, it is of great importance to understand that this is not the only account of validity that is to be considered. I will examine different approaches later in the paper.

Let us now turn to the Aristotelian concept of dialektikê. As we have already noted, the Aristotelian account of the dialectical process can be understood as a rational argumentative dialogue between two agents on a specified subject, one of whom we will call the proponent (P) and the other opponent (O). I am using the term argumentative not to address their willingness to win the dispute at any cost necessary, but only to establish the debate-oriented nature of their discussion. In such a context, the thesis of the discussion is presented by P, who offers a set of premises and formulates a conclusion that he believes should be

universally acceptable for any rational agent because it necessarily follows from the premises. O's task in the discussion is to show that P's argument does not stand.

"The [opponent] has two main jobs: first, to extract a thesis, the 'starting point' for the debate from the [proponent]; second, to try to force the answerer to admit the contradictory of that starting point, by getting the [proponent] to agree to certain premises. Alternatively, the [opponent] can try to reduce the thesis to absurdity (Duncombe, Novaes, 2015).

What Novaes and Duncombe are arguing here is, in fact, that O is only able to defuse P's argument if he either (1) shows that P's starting point (set of premises) is ill-founded, or (2) that his conclusion does not necessarily follow from the premises via reductio ad absurdum analysis, i.e. to show that P's inferential process generated a *non-sequitur* using an indirect method of proof. If he fails to deliver on at least one of those points, he is bound to accept the argument. In other words, O's persistent search for a counterexample can generate two possible outcomes, viz., either he will capitalize with his counterexample and show that the original argument is logically flawed, or he will accept that the argument stands.

The obvious next step is to ask what is the nature of the relationship between logikê and dialektikê. After examining their properties in this chapter, it is only reasonable to search for the connection between the two, since both attempt to establish a model for the process of adequately arriving at a conclusion from a set of premises. This model will later be discussed in the context of *correct reasoning*. As for their relationship, Novaes and Duncombe consider three options; (1) the relationship is historical – dialektikê preceded logikê and provided a basis for its development (2) the two are not connected at all – the mono-agent logikê deals exclusively with structures of arguments which are to be considered valid, and does not venture into the realm of the procedural practice of correct reasoning, and (3) the two share a conceptual ground – as Hintikka (1995) asserts, it appears that Aristotle's treatments of some

logical terms, such as quantifiers, rely on the idea of reasoning as a language game, which is by no means traditionally considered inherent to the Aristotelian account of mono-agent logic.

The explanation that adopts the idea of the shared *conceptual* ground of logikê and dialektikê is precisely what will be the basis for my answer to the central question of this paper that was introduced in the first chapter – "Is logic normative for natural inference?". But before I launch into my attempt of tilting at windmills of this issue, I am now bound to clarify what exactly happened to logikê and dialektikê for them to evolve into what we today know as logic and dialectic.

2.2 THE CONTEMPORARY DISCOURSE

As I have discussed in 2.1, the Aristotelian conception of logikê and dialektikê established a basis for the development of two separate systems, respectively; (1) formal logic, and (2) dialectic. Keeping this in mind, it is still immensely important to address the elements of the preceding systems that were retained through the aforementioned developments and which were eliminated for one reason or another.

The development from logikê to logic was indeed groundbreaking, as the Aristotelian account held its ground up until late 19th century. Aristotle's system was extensively used throughout the Hellenistic and medieval era of philosophy and all throughout the era of modern philosophy.

Eventually, the first serious attempt of constructing a symbolic formal logical system was made by Gottlob Frege in *Begriffsschrift* in 1879. The system that Frege proposed was indeed the first that we could accurately call a system of mathematical logic – it used symbols instead of natural language items, alongside a set of rigorous logical rules of inference and a formally established concept of validity. The new formal notion of validity differed from Aristotle's inasmuch that it broadened the set of arguments which are to be considered valid via formal criterion (which will, by all means, be elaborated further on in the paper). By the same token, the operators that were stipulated inside this new logical system were historically and conceptually independent of dialectic, which obviously wasn't the case in Aristotle's account. Summa summarum, while retaining Aristotle's idea of a systematic study of validity and correct inference, Frege constructed a system which will radically challenge the existing logical paradigm.

His attempt was soon after revisited by Bertrand Russell once he found an inconsistency in Frege's system; he had noticed that Frege's system generated a paradox of autoreference – later to become known as Russell's paradox. At first, Frege protested against the idea of his system being inconsistent, but after some persuasion from Russell, he finally gave in and accepted his oversight. This prompted Russell and Whitehead to elaborate an update of Frege's attempt which they published under the title of *Principia Mathematica* in 1910.

This proposal from Russell and Whitehead will later be known as the classical account of logic. I will elaborate on its properties and formal features in the chapter III. To this day it serves the purpose of the mainstream account of logic. However, it needs to be stated that many extensions were developed around it which attempted to account for the discrepancies between natural inference of rational agents and its rigorous (and often counter-intuitive) principles of deduction.

As for the road from dialektikê to dialectics, the process was somewhat different. The term dialectic took two separate meanings in the context of modern and contemporary philosophy. The first revision of the word dialectic in the western philosophy belongs to the pre-continental tradition. It is often wrongly attributed to Hegel and subsequently Marx, although its first introduction was rendered by Fichte. Namely, it refers to a process of logical-epistemic action, contrasting the thesis with its negation, antithesis, resulting in an abstract unity of the terms called synthesis. Although this concept of dialectics stemmed from the Aristotelian discourse, it most certainly does not pertain to the discussion of this paper.

Conversely, the second revision of the concept resulted in a discourse much closer to the Aristotle's idea of dialectic. As was the case with the Aristotelian account of dialectic which I discussed in the context of Novaes/Duncombe analysis, it implies a dialogue-based discourse held between two rational agents who take opposing sides in an act of argumentation.

However, Aristotle's conception of dialektikê was to an extent narrower than the contemporary account in question. Namely, it was limited to the interlocutors' practice of exposing a contradiction from a set of commitments generated by the assertions of the interlocutors engaged in the activity of debating.

This contemporary expansion of the concept of dialectic turned out to be indeed very useful for discussing the relationship between natural inference and logic. As it is surely the case, the vast majority of reasoning processes conducted by an individual does not occur in an isolated mono-agent reasoning environment, but in a multi-agent debate-oriented discourse. Also, it is important to point out that the phenomenon of dialectic engagement does obviously not pertain to the mundane, everyday dialogical interactions, but only to the deliberate argumentation about a certain subject in which the interlocutors do not share a common opinion or an appraisal of the issue. Moreover, once we are discussing such a formulation of the dialectic process, one can easily see that it is intricately intertwined with the common conception of *natural inference*.

However, it is quite clear that we have still not addressed the elephant in the room, and that elephant is the examination of what natural inference, in fact, is. I have yet to encounter a philosopher that does not have a general conception of the idea of *natural inference*, but when one comes to explicitly addressing the issue, it becomes quite obvious that a plethora of non-trivial problems arises from any of the various approaches to it. This being said, one can always turn to the wise words that professor Dožudić uttered during his lecture on identity during the Summer School of Logic in Rijeka, 2019; "I have yet to encounter an unproblematic definition of anything."

2.3 NATURAL INFERENCE

The debate revolving the concept of natural inference is staggeringly broad, as it has potential to be studied in an array of diverse scientific fields, such as philosophy of logic, epistemology, cognitive sciences, psychiatry and neurology. Because of that, it is of vital importance to understand that as the field of scientific inquiry changes, so does the definition that the author proposes. In this paper I will solely venture into the fields of philosophy of logic and (to an extent) epistemology, so the considerations of this study will be primarily established on philosophical grounds.

Before launching into the technical discussion on normativity of logic for natural inference, it would be quite useful to establish any relevant, universally accepted proposition about the phenomena. So far it seems that not many (reasonable) authors have issue with saying that natural inference is a process of coming to a conclusion from a set of premises via *correct reasoning*. Indeed, at first glance it seems that this truth about natural inference is rather trivial, simply because the term *reasoning* appears to be only a variation of the term *inference* with added intent from the epistemic agent. However, the focus in the proposition shouldn't be on the word *reasoning* but on the modifier *correct*. *Correctness* in this context relies on the general notion of a gap-free, semantic-based process of deriving a non-trivial, relevant proposition from a set of (primarily) implicit, or explicit premises. This stipulation just might provide an adequate basis for commensurability of formal and informal inference later on in the paper.

Now that we have settled on a starting point, several other concerns about the conception of natural inference must be brought to light. Firstly, we simply have to be aware that epistemic agents do not enjoy a perfect cognitive apparatus which would guarantee that their inferences are always correct. They make mistakes, which often leads to a messy discourse, much

different than one within a neatly arranged argument on a piece of paper from which it is perfectly discernable which inferential processes lead to which conclusions. Secondly, some of the mistakes they make appear not to be random at all; the leading researchers in the field have decades of empirical evidence to show for the fact that many mistakes, i.e. errors that subjects make are *de facto* systematic in nature. (Evans, Over, 2004)

In other words, the erroneous inferences that they have made seem to follow a set of implicit rules that are not specific to any agent individually, but show systematic recurrence in certain forms that do not correspond to the pre-specified standard of correct reasoning.

Furthermore, subjects that are not trained in logic often fail to see that they have made an error in the inferential process once they are corrected or otherwise, if the error is brought to their attention. This phenomenon pertains to the idea of *inferential heuristics* – implicit cognitive processes that might as well be evolutionary founded, which apparently make subjects prone to devising intuitive, more economic inferences, while not abiding by the standard of classical logic.

At this point in the paper – before launching into the next chapter on the specifics of normativity of logic for natural inference, it would be fairly useful to delineate the differences between two kinds of languages that are contrasted in this discourse; (1) formal and (2) natural languages. As I have tacitly reflected on the distinctions between the two throughout this chapter, it might be of help if we addressed them head on. Formal languages, which include, but are not limited to the language of symbolic logic, mathematics, model theory and formal semantics, are exclusively devised artificially, in the sense of not having native speakers. Their alphabet comprises a set of symbols that will bear the roles of operators, variables or constants. The sets of operators and constants are finite and strictly defined by syntactic rules. The various strings of such symbols that abide by the rigorous syntactic rules

are called well-formed formulas (wff). The operators express relationships between the terms and account for all of the possible inferences that can be made from the wffs. Formal languages are, by definition, pragmatically independent, i.e. they are not affected by contextual circumstances.

By contrast, natural or ordinary languages are almost exclusively authentic, in the sense of having native speakers. They are primarily in function of conveying information in the real-world setting, allowing the speakers to express their mental content. In terms of rule-governance, they still abide by a set of syntactic rules, however, they are considerably looser when compared to formal languages. Traditionally, the systematic examination of natural languages can be organized into three discrete categories; (1) morphosyntax – the study of rules for formation of adequate words, phrases, clauses or sentences, (2) semantics – the study of meaning, and (3) pragmatics – the study of context. Natural languages are characterized by spontaneous speech, turn-taking oriented discourse between the interlocutors and meaningful exchange of information.

At first glance, one might think that we are trying to compare two very different kinds of systems which share no distinctive features. This, however, might just be a misconception as we will show co-occurring regularities in the two system which indicate that they might be more closely intertwined than it initially appears.

Once we situate this distinction between the two kinds of languages in the discussion of this paper, a couple of quite obvious questions come to mind – “Can a formal language become a model for a natural language?” and even more so – “Can an inference from a natural language be explicitly formulated in a formal language?”.

If we turn out to be keen on answering both of the questions above affirmatively, all the while keeping an eye on the respective historical developments of dialectic and logic, the question

that we need to posit in this discussion is “Can we consider formal logical inference a model for natural inference?” – or even more so “Is formal language normative for natural inference?”.

In order to attempt to answer these questions, we will have to venture into the discussion on argument structures and properties of both natural language and formal logic to establish their commensurability and display their relationship through a model.

III. NORMATIVITY AND ARGUMENT STRUCTURE

3. 1 SYSTEMIC COMMENSURABILITY AND NORMATIVE CONCERNS

Having compared, or rather contrasted, the features of formal and natural languages relevant to this paper, we have come to a number of questions that are indeed quite philosophical in nature. The last one, concerning the normativity of formal logic for natural inference, is by a considerable margin the most demanding in terms of theoretical commitments one makes when answering it affirmatively. Not only that, but in the context of this discussion, by answering the last question affirmatively, one quite certainly ought to see to it that they commit to answering the rest of them affirmatively, as well. Consequently, if we establish that logic is normative for natural inference, we will have accepted that natural and formal systems of inference are, in fact, commensurable.

However, this might not be the case at all. As Gilbert Harman would argue, formal logical inference has very little to do with natural inference. In his book *Change in View* (1986), Harman endorses a distinct position in the discussion which asserts that *theoretical* and *practical reasoning* are two different kinds of cognitive activity, and that essentially, engaging in one (successfully) does by no means imply engaging in the other. n.b., as we are dealing with a slight shift in terminology, it might just be useful to explicate that when Harman uses the term theoretical reasoning, he is addressing formal logical inference, and conversely, when he uses the term practical reasoning, he is addressing the process of natural inference. In his view, they can co-occur and sometimes even affect one another, but not at all necessarily. Ultimately, this position would leave us empty-handed in the attempt of establishing a logical model for natural inference processes. I will try to argue the case for

the opposition, claiming that logical (formal) inference is indeed normative for natural inference. Generally speaking, in this chapter I intend to discuss potential problems for that endeavour. I will elaborate on various properties of arguments and classical logic which will need to be revisited in order to succeed.

It is simply vital to discuss properties that can be attributed to arguments of both formal and natural discourse. This type of logical and philosophical study, as Susan Haack argues in her renowned volume *Philosophy of logics*, starts at the point of asking how do we assess arguments in the most general of terms. One can assess an argument to be stronger than another, more persuasive, more interesting, and so on. Also, one can claim that an argument is, for instance, valid or sound.

As Haack sees it, there are three distinct methods by which we can assess arguments, and consequently, three standards of assessment;

" (i) logical: is there a connection of the appropriate sort between the premises and the conclusion?

(ii) material: are the premises and conclusion true?

(iii) rhetorical: is the argument persuasive, appealing, interesting to the audience?"

(Haack, 1978)

Each of the questions that Haack poses when discussing argument assessment can be answered in the context of a different philosophical or scientific field. The first question is a question for the field of philosophy of logic, the second for epistemology and the third for

psychology. As the type of inquiry of this paper is oriented towards philosophy of logic, my attempt is primarily to study and answer the first question. However, the question will be revisited in a small but relevant way. I will not only attempt to find an adequate formulation of the connection between the premises and the conclusion of formal logical arguments, but will also try to investigate the same connection within the framework of natural inference. Primarily, I am hoping to show that the connections between premises and conclusion of both natural and formal inference are commensurable and that the system of formal inference can serve as a model for the system of natural inference. Furthermore, as we have seen, the claim that logic is *normative* for natural inference is stronger than the one that asserts that logic can *provide a model* for natural inference. The latter claim is, by extension, more difficult to establish and I will try to do so by finding a common ground for their respective notions of correct reasoning.

Most of the descriptive attributes that are assigned to arguments may, by themselves, indicate which kind of argument we are dealing with; traditionally, the most general of categories in which we classify arguments are, obviously, deductive and inductive. And even though addressing this classification appears to be superfluous to anyone who has even taken upon himself to skim through a logic textbook, it is far from trivial. The categories of deductive and inductive arguments are, in fact, determined by the very type of *sequitur* that establishes a relation between the premises and the conclusion. Again, whilst at risk of stating the obvious, one could say that the conclusion follows by necessity from the premises in deductive arguments, while in inductive ones the conclusion is derived from the premises on the basis of probability.

In other words, we could say that deductive arguments are non-ampliative, i.e. explicative, which means that nothing is asserted in the conclusion that is not already (either tacitly or overtly) contained in the premises. Conversely, inductive arguments are said to be ampliative,

i.e. non-explicative, for they assert more in the conclusion than is asserted in the premises (Haack 1978).

So far we have mentioned some properties that can be attributed to arguments – we can say they are interesting, persuasive, valid, fruitful, sound, etc. Turning back to Aristotle's conception of logic and its contemporary 19th-20th century revision from 1.1, it is essential to note that the only property of arguments that is strictly logically defined is validity. It pertains exclusively to deductive arguments (by definition), as it is impossible to render an ampliative argument valid. As we have discussed, Aristotle himself sought that the argument be assessed valid based on its formal structure, which means that any other argument of the same structure will also be assessed valid.

The term 'valid' is thrown around in natural discourse quite a lot and (almost) never in the way that would satisfy its technical definition. As a student of a BA programme in philosophy, I was taught that the concept of classical logical validity can be expressed through two connected conditionals, of which one is embedded in the other; "If it is the case that – if the premises of an argument are true, then the conclusion is necessarily true – then the argument is valid." This modal account of validity is without a doubt – on point, concise and well-formulated. However, it is most certainly not the only one that deserves a fighting chance when dealing with the matters of normativity of logic for natural inference.

This is simply because this definition of validity, taken in its classical formulation, generates something rather counter-intuitive in terms of natural reasoning. The implication in classical logical account is material. This means that if we were to accept this formulation of validity, we would, in fact, be obliged to say (by the definition of material implication) that an argument is valid iff either its premises are false or its conclusion is true. It is quite obvious that people do not adopt that principle, and the reason for it is that conditionals in natural

language are not material implications. This is the biggest red flag that we will need to tend to when approaching the problem of normativity of logic for thought. In section 4.2 I will attempt to find an alternative account of implication that would satisfy the behaviour of conditionals in natural discourse. This will definitely affect the concept of validity, since it is expressed by means of material implication.

The concept of validity is inherently connected to the concept of logical consequence. In order to show their relation, let Γ be the set of premises and Φ be a single proposition. We could rightly argue that if Φ is the logical consequence of Γ, then the argument is valid. This is evidently an indirect definition of validity, constructed via concept of logical consequence. This means that, by accepting this explication, we are able to manipulate the definition of validity by accepting various accounts of logical consequence. This pertains to the central discussion of this paper that we have touched upon on several occasions by now – which account of logical consequence would be the most appropriate to display the connection between correctness in natural inference and validity in a logical system?

For instance, let us introduce two separate conceptions of logical consequence and assess the respective perspectives on the matter that they entail. These exact formulations were proposed by Stewart Shapiro in his paper *Logical Consequence, Proof Theory and Model Theory* (2007).

(1) Φ is a logical consequence of Γ if the truth of the members of Γ guarantees the truth of Φ in virtue of the meanings of the logical terminology.

(2) Φ is a logical consequence of Γ if there is a deduction of Φ from Γ by a chain of legitimate, gap-free (self-evident) rules of inference.

The first thing that comes to mind when examining the former formulation is that it has an epistemic dimension which is integrated in the term *guarantee*. It is semantically oriented, which is evident from its focus on the meanings of logical terms and the notion of truth of the propositions of the argument, and finally, we can see that it corresponds to the classical account of formal logic as the condition of classical *sequitur* is met.

As for the latter formulation, it is quite clear that it relies on syntactic properties of the argument by focusing on deduction of the conclusion from the premises. It is also centered around the rules of inference, as opposed to meaning of the logical terms. By the same token, we can see that this formulation would belong to the tradition of proof theory (as opposed to model theory) as it is implies the use of computability in order to establish that the conclusion *follows* from the premises. As Shapiro himself comments, the concept of computability is related to the notion of a formal *deductive* system.

These various formulations of logical consequence can come in handy when attempting to establish a model for natural inference in a formal setting of a logical framework. Ideally, if one succeeds in modelling natural inference through a formal logical system, they are only one step away from establishing normativity of logic for thought.

Moreover, when talking about validity, one other thing ought to be clarified. When we proclaim an argument to be valid, an oversight is often made. The question that is missing in the proclamation of validity is 'Valid for which system?'. The definition of validity that I have taken into consideration is most certainly adequate for the system of classical formal logic, but what about other systems, for instance, ones whose implication is not material?

I will thoroughly discuss this idea in the chapter IV, specifically in 4.1 and 4.2. For now, let us just keep in mind that an argument is judged to be valid *relative* to the system. Let us call this idea of an argument being valid for a particular logical framework - *systemic validity*.

The common view and terminology revolving the system of classical logic stipulates that validity is a semantic property of an argument. If one wishes to address its syntactic counterpart, the term that is usually used is deducibility. This is to show that syntactic proof differs from a semantic consequence inasmuch that the syntactic proof is carried out through steps by using formal rules of inference. These rules of inference are reliant on the syntactic forms or structures and have nothing to do with the truth values of the premises or the conclusion. Thus, deducibility of an argument is assessed through the process of arriving at the conclusion from the premises while abiding by the rules of inference that are determined inside the proposed logical system. Once we have arrived at the conclusion, it would be appropriate to say that the argument was proven.

Semantic account of logical consequence, conversely, is dependent on two things: (1) the respective meanings of logical terms and (2) the truth values of premises and the conclusion.

As Haack (1978) and to an extent, Dutilh Novaes (2015) see things, the term 'valid' can be observed through a less conservative lens. Dutilh Novaes, for example, uses the term 'valid' even for the syntactic deducibility of arguments. She simply refers to it as *syntactic validity*.

Moreover, Dutilh Novaes (1978) applies the term valid to instances of inference that are not strictly bound to a logical system. This conception is termed *extra-systemic validity*.

"What is going on, though, when one judges an informal argument to be valid? One is claiming, I take it, that its conclusion *follows from* its premises, that *its premises couldn't be true and its conclusion false*. [...] When, intuitively, we judge some ordinary, informal arguments good or bad, something like this conception of validity is being deployed."

(Haack 1978)

This conception might just be what we are looking for. By reconciling the logical validity with its natural-inference counterpart, we would be able to display how logical inference provides norms for thought. As Haack argues, extra-systemic validity is evidently present within the framework of natural inference. For instance, we can assess some statements as tautologous or we can claim that some arguments generate trivial but necessary truths. This is quite far from what Harman would call *practical reasoning*.

These informal accounts of tautologies and necessary truths are obviously much less demanding than the ones explicated within the system of formal logic, however, they do exist. Not all natural inference, of course, corresponds to the rigorous gap-free string of well-formed formulas that deductively follow from one another, but these occurrences of structures that greatly resemble formal logical properties are not that uncommon at all.

Thus Haack notices that if we were, for instance, to construct such a logical system that would be capable of formalising informal arguments and establishing their validity which would correspond to the assessment of extra-systemic intuition of validity in the natural discourse, we would have shown that it is possible to construct a formal system that plays a normative role for thought.

In the following chapter I will address the structure of formal and informal arguments. The proposed schemata, originally introduced and discussed by John Corcoran (1972) will provide an insight into the necessary elements for establishing commensurable concepts of inference and thus become a platform for claiming normativity of logic for natural inference.

3.2 THE METALOGICAL STRUCTURE OF AN ARGUMENT

In order to determine how to address the problem of inference, we first need to shift our focus on the general conception of what an argument, in fact, is. Corcoran frames the issue in the following manner; any set of declarative sentences that is paired with a single declarative sentence forms an argument. As we have discussed in the last chapter, arguments can be attributed great many properties, of which the only one that is logically defined is validity. That being said, when we are presented with a set of declarative sentences P and a single declarative sentence c that are connected in a sequence, they stand in some relation to one another. The proposition c may be a logical consequence of P, but it might not be. P might be irrelevant for c, and so on.

This connection between the set of declarative sentences P (premises) and a single declarative sentence c (conclusion) could be formally displayed as an ordered pair (P, c). Logic itself is not in the slightest concerned with the actual truth values of P or c, its only concern is their logical relation. However, merely from the ordered pair, the logical relation between them is still unbeknownst to us. For us to determine, for instance, if c is a syntactic consequence of P, some reasoning must take place. In other words, we must be able to demonstrate exactly how c follows from P. But as Corcoran rightly argues, reasoning is not a part of the argument. It is external to it. But we will get to that in a moment.

Firstly, let us attempt to establish what role does the concept of logical consequence have in this discussion. It appears that it is quite important as it determines all the formulas that follow from the set of premises P. Now, taking into account the formulation of logical consequence that is implemented in the classical logic, it becomes clear very quickly that there is an indefinite set of formulas that follow from P. There is also an indefinite set of

formulas that do not follow from P. So, an argument, then, is an isolated instance of one out of infinitely many possible logical formulas following from a given set of premises.

So in the context of classical logic, the premises and the conclusion can stand in various combinations that can generate valid or invalid arguments. For example, it is entirely possible, as Corcoran notices, that (P, c) and (P, not-c) are valid in the same framework, provided that P contains a contradiction. This is obviously due to the fact that implication in the classical logic is material and thus *ex falso quodlibet* principle stands. Conversely, it is also possible that (P, c) and (P, not-c) are both invalid at the same time. Corcoran then states that this is the case in which c is independent of P. Many authors, though, see this combination as a mere example of an invalid argument.

Another quite interesting property can be found in these possible combinations of the set of premises and the conclusion. There are specific sets of premises P that for any proposed c (obviously in the same language) either (P, c) is valid or (P, not-c) is invalid. For these sets we can say that they are complete. (Corcoran 1972)

Instances of *complete* sets are, not in principle, but in fact, axiomatic. Throughout the history of philosophy, there have been attempts of axiomatizing certain domains of natural or psychological sciences, one of which is Carnap's famous volume *Logische Aufbau der Welt*, in which he attempted an axiomatization of the very structure of psychological objects in the physicalist conception of space and time. Such attempts were soon abandoned, as the theoretical assumptions integrated in such theories were proven to be inapplicable and suffered a fate of becoming pieces of trivia in the history of development of scientific theories, regardless of its ingeniosity.

In terms of natural inference, however, this conception of completeness appears to be unattainable. None of the registers of natural language could assume such a rigorous set of

premises that would generate either a valid or invalid inference in respect to any sentence of that language. This actually goes to show that if we were insistent of implementing classical logic as a norm for natural inference, we would have to admit that no actual or potential subject could ever live up to the standard. Of course, one could argue that not all axiomatized formal systems are complete in relation to their consequence, and that they are, hence, able to determine the valid and invalid inferences for all its sentences – but we would want to see to it that if we were to construct an axiomatized system for natural inference that we can determine the truth value of all its sentences. This is, however, a mere theoretical concern, not a practical one.

Assessing arguments as valid or invalid by the instrument of classical logic, although it most certainly guarantees arriving at a true conclusion (given that we know to a certainty that the premises are true), is not an adequate representation of how natural inference works. As we have already discussed, subjects fail to infer using such a standard, primarily because rules of inference that they implement in reasoning do not attain the rigorous behaviour of implication that is ingrained in the classical account.

So finally, we arrive at the point of assessing not only the relation of the set of premises P and the conclusion c, but the very process of inferring c from P. Corcoran proposes a scheme which will account for this process of reasoning (or discourse) – designating the letter R to it. Reasoning is an extra-logical concept which adds an epistemic perspective to the system. It is not at all pertinent to the relation between the premises and the conclusion of an argument, but to the processes of inference inside the mind of a thinking agent. Thus, the second scheme will be arranged as an ordered triplet, as opposed to a pair – (P, R, c).

This epistemic-logical structure will now be referred to as a *demonstrative argument*, since the focus is now shifted to the procedure of inference.

The reasoning process that leads an agent from the premises to the conclusion while abiding by a set of inferential rules will be deemed correct, relative to the system that is presupposed. However, approaching the issue of establishing the set of rules that the agent ought to abide by is, in itself, problematic. We have seen in quite a few instances throughout this paper that the set of inferential rules that the classical logical account offers is counter-intuitive to subjects and that are, hence, in need of revision. This means, as I have already discussed that the principles of inference of classical logic will need to be weakened to become applicable in terms of natural inference.

Many alternative accounts of logical systems have been developed throughout the duration of 20th and 21st century which attempted to adapt some of the elements of classical logic which was developed by Russell and Whitehead. In the next chapter I will discuss two separate issues regarding this discussion; (1) does accepting one logical system necessarily entail dismissing another – the debate of logical monism and pluralism, and (2) which elements are, in fact, changed in alternative accounts in relation to the classical one.

IV. ALTERNATIVE ACCOUNTS AND POSSIBLE SOLUTIONS

4.1 LOGICAL MONISM AND PLURALISM AND WHAT IS 'ALTERNATIVE' IN ALTERNATIVE LOGICS

The first question that probably crosses anyone's mind when first presented with a numerous non-trivially different logical systems is – "But which one is the correct one?". The answer to this question is indeed quite intricate and is still debated by the logicians and philosophers of logic around the globe. The term correct can apply to whether the system we are observing guarantees us that we will adopt true beliefs from a set of premises that we know to be true. It can also mean that we will be apt to discern erraneous steps in inference from ones that legitimately lead us to the conclusion. Otherwise, it can mean, under the supposition that one accepts mathematical and logical platonism, that the rules of inference that a system comprises correspond to the priciples ingrained in the structure of the world.

All of these interpretations have merit, but the question should probably be revised in order to get a more informative answer. The revision of this question is proposed by Graham Priest in his article *Logic: One or Many?* (2003). Firstly, he introduces the distinction between pure logics and applied logics. An analogy with geometry goes to show that there are numerous pure geometrical systems which have elaborate, well-formed mathematical structure and that there is really no point in arguing which is better in terms of their theoretical basis. They are all well-founded and internally consistent. This is surely true for different accounts of logic; Boolean, fuzzy logic, Łukasiewicz's three-value logic, intuitionistic logic, relevance logic, etc. all have well-structured axiomatics, adequately defined connectives, and so on. This is reason enough to accept the position of pluralism when discussing pure logics.

However, not all logics behave in the same way when applied to different *kinds* of things. Some appear to be appropriate for e.g. economical portfolios, others for Newtonian physics, others for quantum mechanics and so on.

This is, as Priest claims, an entry point for pluralists to interpret this as a definitional fact that there is no one true logic which is more 'true' than the others. They argue that, for instance, that quantum object do not abide by the same principles that macro-objects do, such as the identity relation. The claim is that a different logical systems ought to be implemented to treat these kinds of entities because of their natural properties.

However, as Priest advocates logical monism – a theory which holds that there is one 'canonical' account of logic – he claims that this issue is easily resolved by the simple statement that the problematic property is not governed by a logical law at all. Although the aforementioned law of self-identity applies to macro-objects without a doubt, it is contingent to them, not essential by any means. And so, while maintaining the monistic position in the debate, he allows for extensions of the classical account, i.e. introduction of laws that are not essential but useful for dealing with objects of different kinds.

This is a vital step in the issue of establishing a normative account of logic for natural inference. One can retain the monistic position and claim that there is, in fact, a 'canonical' account of logic, which allows for some extensions to be introduced in order to make room for its adjustment to another system. Just to make it clear, this is the position that I opted for in this discussion.

Now one can ask how is it consistent to claim logical monism and allow for the account of logical consequence to be changed or modified, as the definition of logical consequence is defined by the version of implication that we adopt. But I do not want to challenge validity in

the classical logical account, just make room for a revision of the concept of *correct reasoning*, so it can be attainable for subjects in the processes of natural inference.

Thus, any definitional extension that I propose in this paper does not regard properties of classical logic, but only the discourse R in the ordered triplet of (P, R, c), proposed by Corcoran. As we have already seen, subjects have issues in recognizing implication in the natural discourse as material, so I will propose a weakened account of it (solely in the process of reasoning) which should still be consistent with the definition of implication in classical logic, but would allow us to say that they still infer *correctly*.

I have consulted empirical evidence that Evans and Over (2004) have used in their volume *If*, which provides an imaginative insight of how implication is *de facto* viewed by users of natural language. I will touch upon this evidence and attempt to settle the discrepancy of intuitions of subjects toward the behaviour of implication in both logical and natural discourse.

4. 2 AN ALTERNATIVE TREATMENT

Evans and Over have elaborated on an interesting and simple experiment done with a deck of playing cards, a marker and a conditional statement written on a piece of paper. As I have already indicated, this experiment was constructed to establish how subjects engage with conditional statements, which should give us a general idea as to how to apporach the revision of implication in the discourse R in the context of natural inference.

The experiment was conducted as follows:

The subjects were provided with a deck of playing cards, and each card in the deck had a letter written on the left and a single digit written on the right side. They were given a conditional statement:

"If there is a B written on the left, then there is a 5 written on the right."

They were asked individually for each card if it makes the statement true or false. The results were consistent throughout the group.

If the participant recognized that B was, in fact, written on the left side and B on the right, they would obviously state that the card makes the conditional true. If B was written on the left, but a digit other than 5 was written on the right side, they would claim that the card makes the statement false. So far, the classical definition of validity would be satisfied. This is where things got interesting. The first problem that they encountered was when there was a letter other than B written on the left side (for example, D), while the right side had a 5 written on it. Taking into account the classical account of implication, the card with D on the left and 5 on the right would render the statement true. However, the participants claimed that the card was irrelevant to the statement, not redering it either true or false. The same thing happened when the letter on the right was any other than B and the number on the right was

any other than 5. In other words, if the card had, for instance H on the left side and 9 on the right, they would still claim that the card does not render the statement true or false.

This type of conditional was originally introduced by the psychologist Peter Watson, who termed it *defective conditional*. The truth table for a defective conditional, thus would look like this:

P	Q	P→Q
T	T	T
T	F	T
F	T	I
F	F	I

The letter "I" in the table stands for irrelevant. Taking a closer look to the priciple behind this variation of implication, it behaves like a material one in the first two interpretations, but is limited to the cases in which the premises are true. This is indeed in line with the epistemic-logical conception of soundness – validity with true premises.

So finally, my proposal is to treat implication in the context of natural inference as a defective one, which does not oppose the conception of logical consequence in classical logic, but only adapts it to the subject's natural reasoning processes. This is to say that subjects are able to determine the existance of *sequitur* when they believe that the premises are true. Also, it is of vital importance to note that for every argument that they judge to be valid by using this conception of defective conditional, the argument would, in fact, be valid in the system of classical logic. However, not every argument that is valid in classical logic would be recognized as such by users of defective conditional.

V. CONCLUSION

In this paper I have attempted to address the question of normativity of logic for natural inference. As we have seen, it is an arduous process with very little room for manouver as the discussion have become quite technical, while remaining under the influence of strong intuitions on the subject. As is the case with most philosophical discussions, due to the lack of empirical evidence, these intuitions have played a crucial role in taking sides in the discussion. I have tried to argue that logic is normative for natural inference through an adaptation of the definition of implication.

The material account of implication appears to cause the most trouble for subjects in the process of natural reasoning, so I have opted for a weakened version of it (exclusively in the context of the reasoning process or discourse R) for which I believe will give us enough to go on in the endeavour of establishing logic's normativity for thought. This, however, is only the inception of the final solution, as many questions remain unanswered.

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