FORMAL LOGIC, INFORMAL REASONING, AND THEIR DISPUTABLE RELEVANCE*

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Abstract

Our commonplace practices of reasoning in natural languages-i.e. informal reasoning- are often believed to satisfactorily map on a formal system of logic-i.e. formal logic- which typically consists of formal syntax, formal semantics, and related proof system. Nonetheless, it then becomes significant to ask on what grounds formal logic legitimately has such relevance to informal reasoning. On one standard view, formal logic governs all rationally admissible tokens of informal reasoning. This view – either in its descriptive or normative construal - has been seriously challenged by Gilbert Harman and Peter Wason who commonly hold that formal logic has no (descriptive/normative) relevance to informal reasoning. This paper provides a critical survey of these distinct accounts, narrowing down the scope of their common thesis based on the possibility of logical pluralism. As it argues, a singular formal system of proof such as classical first-order deductive logic cannot single-handedly satisfy the standard view.

Keywords: *Formal logic, Informal reasoning, Normativity, Selection task, Logical pluralism.*

FORMEL MANTIK, ENFORMEL USLAMLAMA VE BUNLARIN TARTIŞMALI BAĞI

Öz

Doğal dillerde temsil kazanan gündelik uslamlama pratiklerimizin -yani, enformel akıl yürütme örneklerinin- genellikle formel sentaks, formel semantik ve ispat sisteminden oluşan formel bir çıkarım sistemi -yani formel mantık- tarafından tatmin edici bir şekilde haritalandırılabileceğine inanırız. Ancak, formel mantığın enformel akıl yürütme ile olan bu gösterim ilişkisinin hangi zeminde meşruiyet kazandığını sormak önemlidir. Standart bir görüşe göre; formel mantık, enformel akıl yürütmenin rasyonel olarak kabul edilebilir tüm örneklerini yönetir. Bu görüş-betimleyici ya da normatif yorumuyla- Gilbert Harman ve Peter Wason tarafından ciddi bir şekilde sorgulanmış ve her ikisi de formel mantığın enformel akıl yürütme süreçleri ile (betimleyici/normatif anlamda) bir alakası olmadığını savunmuştur. Bu makalede, standart görüşe karşı argümanların eleştirel bir incelemesi sunulurken standart görüş mantıksal çoğulculuk perspektifinden yeniden okunacaktır. Makalede tartışılacağı üzere, birinci dereceden klasik dedüktif mantık sistemi gibi tekil bir biçimsel ispat sistemi bir başına standart görüşü karşılayamaz.

Anahtar kelimeler: *Formel mantık, Enformel uslamlama, Normatiflik, Seçim testi, Mantıksal çoğulculuk.*

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1. Preliminaries

Typically, formal logic stands for a formal derivation system consisting of formal syntax (e.g. Boolean grammar), formal semantics (e.g. truth-conditional connectives), and related proof system. In logic, our most commonplace practices of formal logic are generically intended to map onto the instants of everyday reasoning embodied in natural languages. There seems nothing surprising about subsuming everyday reasoning under logical form and formal deductive relations once we endorse the commonplace definition that logic is the study of 'correct' reasoning.[1] Consequently, logicians might systematically rewrite even the most basic instants of everyday reasoning in the standard logical form which stands for the discursive and truth-conditional relation held between at least one premise and one conclusion. Nonetheless, it then becomes significant to ask on what grounds formal logic is a legitimate apparatus to thoroughly schematize informal reasoning. In other words, such a relevance between formal logic and informal reasoning must be substantially grounded if schematizing informal reasoning by formal logic is not an arbitrary or tentative choice for practical reasons.

Here, one standard view comes out to substantivize the schematic relevance of formal logic to informal reasoning. On this standard view, formal logic governs all rationally admissible tokens of informal reasoning. As this austere thesis suggests, the so-called inferential rules of informal reasoning are – spontaneously and/ or ideally- exhausted by the rules of formal logic to the effect that every admissible token of informal reasoning structurally mirrors axiomatic tokens of formal deductions. The picture drawn here has been a dominant view on the relevance between logic and reasoning and it can be traced back to Aristotle's several works.[2] Perhaps, early Wittgenstein's *Tractatus* presents a more subtle variant of the standard view although it cashes it out by endorsing a type of logical atomism which roughly holds that the world consists of the plurality of facts in logical space.[3] According to him, the world (i.e. the totality of facts), language (i.e. truth-evaluable sentences describing the world), and thought (sensible propositions about facts) are structurally unified with each other through the logical form to the effect that an expression, if it is meaningful at all, isomorphically mirrors the world at its logical joints. Consequently, such a Tractarian conception suggests that our correct tokens of informal reasoning indispensably accord with the logical space within which the world already resides. In the face of the standard view, Wittgenstein's account in Tractatus seems to naturally entail that every sensible token of reasoning is to abide by the logical structure embedded in the world as it is.

Furthermore, the standard view is often construed in two senses: a descriptive one and a normative one. As the descriptive construal posits, formal logic axiomatically determines how we informally reason in a rationally admissible way. In this sense, the view seems to be a psychological thesis about the formal roots of how a certain cognitive mechanism works and produces inferential outputs in natural languages. On the other hand, the normative construal of the standard view contends that logic axiomatically determines ideal norms about how we ought to reason in a rationally admissible way. Accordingly, endorsing the normative relevance between formal logic and informal reasoning simply means that the classical rules of formal logic constitute inferential norms for informal reasoning so that agents ideally and correctly reason by following these rules. As a result,

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1 Here, I intensionally endorse a very liberal conception of informal reasoning since we can construct such argumentations in radically divergent ways depending on vastly distinct sorts of premises and inferential procedures we might employ in a token of informal reasoning. Such premises in natural languages might bear divergent contents such as sense-perceptual, intensional, context-dependent, pre-propositional, and anaphoric contents both at the object language level and the meta-language level while a token of informal reasoning might proceed from one premise to another in equally distinct ways (logical or not) such as nomological, dialectical, abductive, associative, heuristic and so on. Regarding such diverging instances, I merely hold that a token of informal reasoning stands for an inferential procedure by which an agent thinks that he discursively ends up with a view embodied in a given natural nature.

2 Although Aristotle's views on logic were textually scattered throughout his works in terms of their historical appearance and reception, the ancient commentators of Aristotle such as Alexander of Aphrodisias conventionally grouped Aristotle's six logical treatises into the single codex named *Organo*n, which includes *the Categories, On Interpretation, the Prior Analytics, the Posterior Analytics, the Topics, and On Sophistical Refutation*s. As the title *Organon*, i.e. the instrument, suggests, Aristotle has been thought to discuss in those treatises that logic is a normative instrument or method for distinct modes of reasoning. As Woodcox (2022) and Zingano (2017) extensively discuss, Aristotle puts forward distinct ways of proving such as physical (phusikôs), logikôs (logical), analutikôs (analytical) argumentations each of which represents a distinct method of justification on specific subject matters. Yet, what Aristotle means by logical argumentations or formal arguments does not correspond to sheer formal logical deductions or syllogistic forms since formal arguments in the Aristotelean sense employ philosophical or metaphysical proofs, so such argumentations always entertain propositions embodied in natural languages. Yet, Aristotle's influence on the standard view can be more vividly observed regarding his idea that logic is a normative means to provide admissible proof. In this respect, every admissible logical argument, for Aristotle, is governed by formal logical principles such as *the principle of non-contradiction*.

3 Wittgenstein's *Tractatus* seems to favor the standard view with a special emphasis on the ontological status and composition of the world through ascribing inherent logicality to the world as the subject of our language and thoughts.

the rules of formal logic stand out as governing norms for informal reasoning tasks so that the question of how we reason correctly seems to be directly relevant to the question of whether our reasoning follows the rules of formal logic. Furthermore, it might be a simple mistake to fundamentally isolate one construal from the other since endorsing a certain stance on how we informally reason in rationally admissible instances also indicates how we ideally reason to the effect that idealized tokens of informal reasoning constitute norms to follow in each token. Thus, these two senses of the standard view do not manifest fundamentally different stances on the relevance in question, however, they merely reveal intertwined or complementary aspects of the same thesis. Notably, the standard view together with its two senses further implies that rationality and rational agency immediately hinge on agents' capacity for following the rules of logic once we endorse that one's being rational entails one's capacity for reasoning correctly.[4]

Still, the standard view – either in its descriptive or its normative construal - has been seriously challenged by Gilbert Harman and Peter Wason who share the claim that formal logic has no (descriptive/normative) relevance to informal reasoning. Relevantly, Peter Wason's (1966) *selection task* and its subsequent variations in cognitive science are often construed to degrade the plausibility of the standard view in the sense that rationality or rational agency does not strictly thrive on having a capacity for reasoning with logic. In philosophy, Gilbert Harman (1984, 1986, 2002, 2009) makes an independent case that formal logic does not bear any direct and normative relevance to informal reasoning. This paper provides a critical survey of these distinct accounts, narrowing down the scope of their common thesis based on the possibility of logical pluralism. As it seeks to argue, a singular formal system of proof such as classical first-order deductive logic cannot singlehandedly satisfy the standard view although it does not amount to eliminate that a single formal system of proof axiomatically might govern certain derivations within the scope of certain sorts of informal reasoning. Regarding this end, the paper will initially explicate the standard view together with its two senses. Secondly, it will critically explore how and why the results obtained by the selection task and its variants undermine the standard view while indicating that those test results, which merely hinge on the first-order classical deductive logic, are inadequate to rule out the standard view in its normative sense. Thirdly, the paper will discuss how Harman's account takes issue with the normative construal of the standard view, and it will argue against Harman in terms of logical pluralism. Finally, it will conclude the discussion by revising the scope of the standard view.

2. On the Relevance Between Formal Logic and Informal Reasoning

In broad, reasoning, at the conscious or public level, corresponds to various tokens of agents' "deliberate thought, planning, problem-solving, scientific theorizing and prediction, moral reasoning and so forth" (Stenning & Van Lambalgen, 2008: 4). Here, the primary concern about reasoning is as to how agents manage to entertain such tokens of cognition. In other words, we might initially ask the question of how we reason at the linguistically embodied level. As Engel points out, such a question demands a descriptive account "presumably a psychological one of how humans reason, a theory of their reasoning abilities and their reasoning performances" (2006: 219). In this respect, there is a generalized consensus that we reason in a principled way – one way or another. That is to say, we ideally reason with the rules of a formal system and/or of formal systems that might singularly or exclusively hinge on certain logical systems, cognitive theories, "scientific methodology, heuristics, probability, decision theory" and so on (Stenning & Van Lambalgen, 2008: 5).[5] What exact formal system is operational in informal reasoning can vary from one account to another. Nonetheless, the accounts on the question of how we

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4 Throughout the paper, I tentatively agree with the widespread convention that rationality corresponds to the state of being governed by reason. Regardless of the controversial aspects of such a depiction, the main thesis of the standard view has direct and strict implications for rationality in this sense.

5 Here, it is important to reiterate that the standard view, which has been addressed so far, stands for a generalized thesis that subsumes distinct views affirming the relevance of formal logic to reasoning in one way or another. That is to say, the proponents of the standard view might subtly or considerably differ in the portrayal of this alleged relevance between logic and reasoning although they share the fundamental thesis affirming the generalized thesis that logic governs reasoning. As hinted before, Aristotle, for instance, defends the standard view in terms of certain modes of reasoning such as analytical and syllogistic reasoning while the relevance between logic and reasoning turns out to be a mark of rationality which constitutes the essential function of humans. On the other hand, ideal language philosophers such as Frege and early Wittgenstein endorse that the relevance between logic and reasoning provides a semantic criterion for language so that every sensible token of informal reasoning must be within the limits of logic. As will be discussed in this section, the proponents of the standard view might further construe this generalized thesis either descriptively or normatively. Again, some theorists such as Jean Piaget think that logic spontaneously governs reasoning in adults as a natural stage of cognitive development while philosophers such as Frege believe that logic should govern reasoning in terms of ideals such as speaking meaningfully, truth-evaluably and consistently.

reason commonly presuppose that there is one formal system or another which stands for how ordinary agents manage to involve such cognitive processes once they endorse the standard view in one way or another. As introduced earlier, the standard view merely holds that formal logic as a formal system of deduction "constitutes the very fabric of thought" in the sense that every admissible token of reasoning indispensably derives from formal rules of deduction (Stenning & Van Lambalgen, 2008: 8). Hence, formal logic in this constitutive role accounts for the very possibility of reasoning to the effect that a formal system of deduction is to describe how we reason in general.

Once we endorse such a formal system accounting for reasoning descriptively on theoretical grounds, the adopted formal system might be further taken as a norm on how ordinary rational agents "correctly" or "ideally" entertain thoughts in a deductive manner (Samuels & Stich, 2004: 280-282). Notably, it is worth saying that such a formal system, which is proposed to substantivize the conditions of reasoning as such and such, might also function to categorically constitute norms to formalize or evaluate any further token of reasoning. In other words, some cognitive process that does not follow the ascribed formal set of rules categorically cannot be an ideal token of reasoning to the effect that such a formal set of rules demarcates the borders for what counts as reasoning at its best and for what counts as rational. To illustrate, the rules of first-order classical deductive logic, as the standard view suggests, function as a means to describe what counts as valid deductive reasoning and what does not.[6] In brief, we can draw some categorical norms for the practices of informal reasoning by simply reflecting on the formal system of rules that capacitate reasoning in the first place. In doing so, we might regulate or adjust a given token of an inferential process to confirm and formalize it as a token of reasoning with respect to the rules of formal logic. Hence, any token of inductive deduction, for instance, would be an 'un-ideal' way of reasoning if one admits that reasoning is particularly governed by the rules of classical deductive logic.[7]

In this respect, formal systems of logic- which are taken as both descriptive and normative means to form informal reasoning- resemble description maps. Such maps fundamentally describe the spatial relations and more about certain locations, and yet they might also be used to prescribe the best way to travel from one destination to another. Similarly, the rules of formal logic, for instance, outline the derivational steps in a 'genuine' token of reasoning if these rules reflectively provide directives to a rational agent on how she arrives at a certain conclusion from some given beliefs. Respectively, Harman underlines the point that descriptive and normative aspects of the very question of how we reason are intimately intertwined with each other, yet the normative aspect of the question, according to him, is the "idealization" of the descriptive aspect (1986: 7). Thus, one's compliance with the given rules of reasoning in her deductions ideally bears the mark of formal logic. As an extension of the standard view, one's compliance is often considered to be on par with one's being rational. That is to say, the standard view also implies that someone is rational only if she reasons with formal logic. Respectively, Dutilh Novaes underlines that "the starting point of" the standard view is "the (Kantian/Piagetian) assumption that the canons of deductive reasoning (as captured in e.g. syllogistic logic) provided the foundation for rationality, and the assumption that humans are indeed rational" (2012:153).

In conclusion, the standard view on the question of whether formal logic is relevant to informal reasoning austerely states that informal reasoning is governed "through instantiations of rules and schematic substitution" derived from formal logic(s) (Dutilh Novaes, 2012: 115). Hence, this view further eschews that logical rules function as norms about how agents ought to reason in an ideal or correct way. Once we agree on the idea that rationality is a matter of one's cognitive ability for reasoning ideally, then the standard view further entails the

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6 Perhaps, the first-order classical deductive logic, or as often called standard logic, which can be schematically represented by either truth-functional object-level predicate logic or propositional logic, is the most exposed and studied formal logical system in philosophy and logic teaching. Typically, such a system contains logical constants ($\land$, $\lor$, $\sim$, $\rightarrow$, $\leftrightarrow$, $\forall$, $\exists$, and variables) each of which has a truth-conditional contribution to the formulas established by non-logical constants (atomic sentences, names, and predicates) in the given object language. Again, its proof system is coined as deductive in terms of how a conclusion follows from premises in a valid argument.

7 Here, there are various sorts of formal logical systems that partially or wholly differ from the classical deductive logic with respect to formal syntax, semantics, and proof theory. Some formal systems such as inductive systems entirely differ from the classical deductive logic, especially in terms of proof theory. Drawing on Sider (2009), it is still worth noting that some formal logical systems directly spring from the first-order classical deductive logic so that they slightly or moderately contain the formal syntax, semantic rules, and proof-theoretical values of the standard logic. In this respect, there are three sorts of "modifications of standard logic": "extensions [e.g. modal logic], deviations [e.g. Scheffer Stroke], and variations [e.g. Polish notation]" (Sider, 2009: 9). Interestingly, such modifications as in the case of modal logic are mostly employed to make formal semantics conform to natural language semantics. Throughout the paper, I do not view nor mention such modifications independently of the standard logic.

consequence that one's being rational is a matter of her competence or performance to comply with the rules of formal logic. Nonetheless, the standard view- along with its two senses and further implications - does not seem to be far from controversies. In what follows, this paper will critically evaluate some key controversies about the standard view.

3. Objections from the Selection Task

As mentioned above, the standard view in its descriptive sense can be construed as a platitude about human cognition. Accordingly, Jean Piaget, a well-known developmental psychologist, pioneered and promoted the standard view as a psychological thesis to characterize how an agent's cognitive skills develop through youth (Dutilh Novaes, 2012). According to him, an agent acquires cognitive maturity only when she acquires the cognitive competence and practical proficiency for reasoning with formal-deductive rules of logic (Stenning & Van Lambalgen, 2008). Just as the standard view in its descriptive sense portrays formal logic, Piaget intrinsically subsumes agents' admissible (mature) tokens of reasoning under agents' ability to reason logically although he also spares room for extrinsic contributors such as education in the development of rationality through mastering formal logic and logical rules. Nonetheless, this cognitive picture of the standard view has been called into doubt through the standing results of several experiments designed to question if formal-deductive rules of logic bear any functional import in the actual tokens of informal reasoning.

In this vein, Peter Wason (1966) pioneered a series of paradigmatic experiments, commonly known as a 'selection task', to scrutinize whether ordinary rational agents do reason logically (Dutilh Novaes, 2012; Samuels & Stich, 2004). On varying occasions, the selection task has been re-conducted and reproduced with different participants who had similar levels of education about formal logic. However, any such instance of the selection task aims to assess whether formal logic has relevance to the question of how we informally reason. In this regard, clarifying how the selection task deals with the standard view becomes significant for the standard view in question.

In the initial step of Wason's selection task, the participants, who share a similar level of education with no specific background in logic, are given four cards each of which has a letter on one side and a number on the other while the only one side of each card must be visible to the participants in each set-up where these cards are randomly arranged for each participant. At this point, for the sake of brevity, suppose the presented cards accordingly display [E], [K], [2], and [9]. As a main premise of the experiment, the subjects are then asked to answer the following question: Which card or cards you must select and turn over to verify the conditional 'If a card has an even number on one side, then it has a vowel on the other side'? Once we endorse the standard view we are to interpret the selection task above as follows: Rational agents are (consciously or spontaneously) in a position to recognize the natural language conditional "if…then" and carve it out as the material implication '$\rightarrow$' if and only if rational agents indeed ideally reason with the rules of implication in formal logic. Provided the standard view, the participants in the selection task, if they are indeed rational at all, are expected to turn the cards complying with the given conditional having the properties of logical implication '$P \rightarrow Q$', namely the cards [2] and [K]. Because only these two cards satisfy 'If P then Q' considering its logical equivalent to 'P and not Q'.

Unlikely, the results of the selection task and its variants undermine rather than affirm what the standard view projects about ordinary rational agents' selections in the given task. Here, the results interestingly demonstrate that most participants did not pick the expected pair - [2] and [K]- and their responses were rather eclectic with no significant propensity in favor of the logically implicated pair. Thus, the selection task shows that ordinary people do not reason with formal logic- at least with first-order classical deductive logic. Here, the selection task can be fairly questioned on a few points. Covertly holding Fregean or Russellean logicism about natural languages, the selection task rests on the platitude that any given well-formed sentence such as the given conditional in the task has an intrinsic logical form or deep grammar. Yet, the selection seemingly further attaches this platitude to the standard view to the effect that these logical forms of well-formed sentences, for the standard view, are spontaneously or consciously attainable by rational agents if these agents reason with logic in their natural state. That is to say, the selection task presumptuously extends the standard view so that the logical form of the given conditional, for instance, must be transparent to the participants and they ought to immediately recognize it

as a material implication, i.e. as a rule of inference in the first-order classical deductive logic if only if reasoning logically requires one's somehow recognizing the logical forms of her each belief or thought. Nonetheless, such an interpretation of the standard view in the face of the selection task is unfairly restricted as if there must be only one logical form such as the material implication attainable by any given single well-formed sentence that represents a singular belief or thought in agents' deductions. Rejecting the necessity of a singular interpretation for each well-formed sentence, a proponent of the standard view might account for the participants' so-called failures in capturing the material implication form in the given sentence. Initially, assigning a logical form to a natural language sentence is always a tricky business since it hinges on what semantic content or functions rational speakers both conventionally and contextually assign to each categorematic and syncategorematic terms of the given sentence. Therefore, the participants in the selection task might associate distinct contents/ functions and thereby distinct logical forms with the given sentence 'If a card has an even number on one side, then it has a vowel on the other side'. Such variations in cashing out the sentences in logical forms do not have to be merely a matter of natural language semantics since rational agents might merely reason with varying formal logical systems with distinct formal semantics when they semantically decode what the selection task asks to infer (Dutilh Novaes, 2012: 147). If this is the case, the selection task does not eliminate the standard view in its broader sense. If a rational agent, who allegedly fails to jibe with one set of formal inferential rules, might still follow another set of formal rules semantically compatible with her initial interpretation of the given conditional statement, then it is still sound to argue that rational agents reason with logic in one way or another.

In addition to the above discussion, the selection task presumptuously widens the scope of the standard view in one more sense. The selection task is claimed to falsify the standard view based on the presumptuous narrative that a participant -if she reasons logically as the standard view contends- must recognize and manipulate the rules of formal logic to solve the given puzzle only. However, the standard view does not necessarily endorse this narrative concerning the notion of recognition stipulated there. For one thing, a participant, for the standard view, does not have to formally follow the conclusion 'Q' from 'P→Q' and 'P' whereas she might fairly entertain practical and informal inferences that spontaneously share the inferential form of modus ponens. Simply because there is a distinct level of transparency involved in the tokens of informal reasoning to the effect that an agent can be unaware of the formalized structures of everyday instances of reasoning. Hence, it is compatible with the standard view that agents might spontaneously entertain rules of formal logic in their tokens of informal reasoning although they might still fail to recognize and apply them in their formal representations. Therefore, it can be fairly argued against the selection task based on one's failure to formalize their spontaneous tokens of reasoning by reflecting on them with some formal structure within some adopted formal system of logic. So, the real question here is as to why the participants fail to bring the rules of formal logic into the conscious or attainable level in the given task.

Hereby, some further modified variants of the selection task such as the 'suppression task' seemingly seek to address the question of why an agent whose rationality, to wit, logicality is taken for granted still fails to capture and solve a very simple logical puzzle in classical deductive logic. At this juncture, it is worth underlining that the supposed logical form of the given conditional in the selection task is covert and vaguely tenable in a few respects depending on various factors such as the relevant sentential structures, agents' psychological states, and so on. Accordingly, Wason and Shapiro (1971) presented a modified version of the selection task where the relevant conditional sentence initiating the logical puzzle in the selection task was swapped with some other conditional sentences from everyday content. As they noted, the participants more easily and successfully recognized the logical form-i.e. the material implication- behind the conditionals having everyday content to the effect that they performed better in solving the given variant of the selection task (Dutilh Novaes, 2012: 117-149). Furthermore, Evans (2002) conducted a more transparent experiment than the selection task in terms of the logical puzzle at display, and the results of this variant also inclined to affirm the standard view. Once more, Wason and Green (1984) noted that some conditionals about deontological topics facilitate the participants' recognition of the formal logical rule in question. Concisely, such modified variants of the selection task commonly suggest that participants better capture the logical form of a given sentence in the selection task once they are practically and contextually acquainted with the sentential content and form of the given sentence. Thereby, the results obtained in such modified variants of the selection task reinforce the standard view by delivering a perspective

that rational participants might fail to recognize the very same rules allegedly governing their reasoning when these rules appear in descriptive or abstract forms.

Hence, it can be discussed that some modified variants of the selection task do not undermine the standard view in its entirety. Specifically, these variants of the selection task seem to suggest that the participants, just as the standard view anticipates, reason with the logical rule -i.e. modus ponens- when the given selection task is better formulated by a semantically concrete and overt question within a relatable context of discourse. Nonetheless, the alleged 'attainments' of participants in these variants of the selection task do not necessarily reinforce the idea that we spontaneously reason with the deductive rules of logic such as modus ponens when the selection task is conducted within a more concrete and overt set-up. No matter how the selection task is linguistically formulated, both its initial presentation and its subsequent variants rest on the same problematic presupposition on the question of when a participant will be acknowledged as rational in the given axiom of choice. For one thing, it is worth noticing that the selection tasks – including its initial and modified variants- already affirm or disaffirm the standard view based on the presupposition that the participants will be acknowledged to reason with logic only if they notice and appeal to the deductive rule of modus ponens overtly or covertly placed in the given tasks. In other words, participants' rationality assessments in those tasks amount to their attainment of using one singular semantic rule (*modus ponens*) and the relevant logical consequence within the formal semantics of standard deductive logic. Consequently, the experimental results in question seem to demonstrate that the participants are supposed to reason with a certain semantic rule within a certain system of logic regardless of how they follow or fail to follow these rules. Therefore, these experiments promote the idea that rational agents either reason with a single formal system of logic or logic has no relevance to reasoning at all. However, such a presupposition unwarrantedly endorses that there is only one system of logic-the standard deductive logic- to entertain in our tokens of reasoning. Here, l*ogical pluralism* suggests a counter position against such an unwarranted stance so that one might fairly argue that rational agents follow a variety of formal rules within various logical systems depending on their semantic interpretations of the well-formed sentences in question. So, one might further hold that the participants who seemingly fail to appeal to modus ponens possibly reason based on some other formal semantics and formal rules depending on their initial axiom of choice even though their tokens of reasoning fall apart from a particular formal system such as the classical deductive logic. In other words, the selection task theorists such as Wason unwarrantedly embrace that the standard view inherits logical monism and thereby, they hold that the participants, if they are rational at all, only reason with formal deductive rules of a single system of logic. If the results of such tasks -which designate to assess whether agents can employ modus ponens on any sensible occasion – affirm or disaffirm the standard view, such tasks already ought to warrant that there is only one correct logic and one correct system of formal derivation to the effect that logical pluralism is implausible. Otherwise, it is feasible to read the standard view with a pluralistic perspective on logic so that a rational agent reasons with some distinct system of logic on each occasion of use.

With this pluralistic approach at hand, it is worth briefly introducing logical pluralism and how it might contribute to the discussions about the standard view. Logical pluralism stands for a family of theoretical stances that generically agree on the fundamental thesis that "there are distinct, but equally good logics" (Caret & Kissel, 2020: 1). Here, it is important to note that the conception of 'plurality' by no means corresponds to any sort of unprincipled or unrestricted notion of relativity as if logical pluralism defends for a naïve idea that every reasoner has their own logic each of which is equally admissible in the same occasion of use. Instead, logical pluralists often argue that some formal systems and their accompanying principles of derivation "are clearly not candidates to play the intended role of logic" in a given occasion of derivation (Caret & Kissel, 2020:1). To put it simply, logical pluralism generically holds that there is a variety of logics each of which constitutes a distinct but equally admissible way of derivation depending on what we intend to prove in the given occasion of use. Hence, some formal system of logic such as second-order fuzzy logic functions as the correct way of proof in a given token of sentences while some other logic does not offer much for the same set of sentences. The idea behind the variety of logics can be traced back to the Carnapian characterization of logic as a formal theory of proof. As pointed out earlier, such a formal system consists of three compartments- i.e. formal syntax, semantics for the formal language, and a definition of validity conditions for them. Regarding those constitutive organs of a formal system of deduction, one might construct various logics by simply adopting divergent syntax,

semantics, or proof-theoretical rules only if they constitute a coherent and complete bulk of syntactic, semantic, and proof-theoretical rules. Accordingly, a formal system of deduction can be diversified based on how we coherently construct these three parameters with different sets of formal language, rules of deduction, and validity conditions. In this vein, philosophers such as Carnap and Tarski favor the notion of logical pluralism based on the possibility of differentiations of linguistic (mostly semantic) conventions (Caret & Kissel, 2020:2-3). For instance, some languages in which modal connectives or tense markers have truth-conditional contributions are thus captured correctly only employing a certain formal system of logic such as modal logic or tense logic. Although some philosophers such as Carnap diversify logic based on diverging semantics, some other pluralists also argue that proof-theoretical rule which shows how to infer in a given system of deduction might vary from one logic to another. Regardless of securing the plausibility of logical pluralism, it is evident that the possibility of logical pluralism weakens the above objections against the standard view to the effect that they at best contend that rational agents do not ideally reason with classical deductive logic.[8] In other words, the possibility of equally correct logic(s) indicates that these objections against the standard view deliberately or not- come with an extremely limited scope of analysis. Hereby they do not satisfactorily disaffirm every possible formal system of proo and they only provide a very narrow scope designated to cover the classical deductive logic and the cases of practical reasoning fully propositional at the conscious level.

To sum up, the selection task seemingly takes an issue with the standard view since its results appear to undermine the idea that ordinary rational agents, under allegedly overt and normal discourse conditions about a token of inferential processing, are expected to reason with formal rules of deductive logic. In doing so, the selection task presumptuously construes the standard view as if it must inherit equally debatable two presuppositions: (i) the de-semantified or abstract rules behind agents' spontaneous deductions are transparent to them so that they can make use of these rules at a conscious level in any informal representation; (ii) rational agents ubiquitously recognize the very same logical structure and relations by a well-formed sentence without any interpretational deviation. Yet, these presuppositions are not well purported to exhaust the standard view in its every possible construal. Respectively, the standard view seems compatible with the possibility that rational agents might fail to carve out every formal logical rule or form associated with a given token of informal reasoning. Furthermore, it is also plausible that one's reasoning without classical deductive logic does not necessarily imply the absence of any formal logical rule or system in a rational agent's token of informal reasoning once we admit that one might reason with some non-deductive or non-classical logic in the given token of reasoning. Thus, even if the selection task disparages the relevance of the first-order classical deductive logic to any token of informal reasoning, it does rule out that there may be some other formal system or systems governing informal reasoning. In a similar vein, the selection task does not eliminate the possibility that agents follow distinct systems of logic in their various tokens of informal reasoning depending on under what formal semantics they interpret the given reasoning tasks. Furthermore, the variants of the selection task, in return, provide a ground for defending logical pluralism while keeping logic(s) as a norm for reasoning.

In addition, the experimental results mentioned above only seek empirical grounds as to how people reason, and yet these results are held to claim that the standard view seems to be inadequate unless we take ordinary agents as irrational in terms of their compliance with formal (deductive) logic, or unless we incorporate logical pluralism into the standard view. On the other hand, Harman (1984, 1986) evaluates the standard view on theoretical grounds in terms of the plausibility of pairing formal logic with informal reasoning. In this respect, he argues that formal logic has neither normative nor descriptive relevance to informal reasoning, so he theoretically trivializes the whole set-up that the standard view proposes in its every construal. At best, the results obtained from the selection task trivially reinforce Harman's stance on the relevance between formal logic and informal reasoning. In what follows, I will explain Harman's account and his arguments for the stance that the rules of formal logic have no normative relevance to informal reasoning.

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8 Here, it is important to point out that logical pluralism plays an explanatory role in my argument to make the point that the objections from the selection task, along with Harman's arguments against the standard view, presumptuously hold that the standard view inherits logical monism. Thus, I have no particular ambition to defend the plausibility of logical pluralism although many proponents of logical monism take issue with the variety of logics based on the claim that such allegedly 'divergent' systems of formal proof are by no means self-contained systems, but they are either modifications or extensions of one singular system of deduction such as the standard deductive of logic.

4. Harman's Objections to the Standard View

Harman (1984, 1986) straightforwardly denies the standard view based on the austere claim that "it is a fundamental error to think of basic logical principles rather than as rules of inference" (1984:107). In this respect, he provides a two-folded argument against the claim that formal logic has a special role in reasoning. On the one hand, formal logic, as he argues, has nothing to do with the rules of beliefs and belief revisions which are allegedly definitive for informal reasoning. For example, "modus ponens does not say that, if one believes p and also believes if p then q, then q" since one can revise any such belief for any practical reason during processing a token of informal deduction (Harman, 1984:107). Relatedly, Harman further holds that formal logic, on the other hand, has distinct characteristics of deduction which cannot exhaust the tokens of informal reasoning. To this end, Harman starts by focusing on the normative construal of the standard view.

As mentioned earlier, the standard view has two senses. First, it can be posited with a descriptive emphasis to the effect that formal logic accounts for how agents naturally conduct informal reasoning. Just as Mill's *psychologism* stance on logic suggests, the standard view in this manner of construal corresponds to a psychological thesis about how a rational agent reasons in its natural state (Harman, 1984; Stenning & Van Lambalgen, 2008). Additionally, the standard view can further be construed with a normative emphasis to the effect that formal logic ideally provides constraints for agents to abide by. Just as Frege's *logicism* implies, this construal entails the methodological thesis about how a rational agent ought to reason (Harman, 1984). Regarding the nuance separating these two construals from one another, it is worth noticing that the former construal obtains formal logic as a psychologically inherited foundation of informal reasoning in a natural state whereas the latter construal holds it as an idealized apparatus to form informal reasoning in its ideal state. In each construal of the standard view, formal logic is paired with informal reasoning so that their relevance is indispensable for understanding how informal reasoning works. In this regard, Harman thinks that the putative relevance between formal logic and informal reasoning does not seem to be self-evident and inevitable once some disparities between these two inferential systems are taken into account. Based on such conceptual disparities, he consequently holds that formal logic does not constitute a descriptive nor normative theory of informal reasoning, and he therefore posits that the rules of formal logic cannot be paired with the rules governing informal reasoning (Harman, 1984, 2002). In a similar vein, Harman's critical stance on the standard view heavily relies on his characterization of formal logic and informal reasoning in virtue of his related conviction on the allegedly irreconcilable disparity among them. Hence, the plausibility of Harman's account boils down to the question of how cogently he conceptualizes formal logic and informal logic based on their allegedly incompatible features. Thus, it is worth analyzing his notions of logic and reasoning in virtue of his reasons for the irreconcilability between them.

First, he defines formal logic as a formal system of proof or argument that provides "the rules of implication" determining how to derive one semantically complete element (a proposition or a statement) from another in each body of the argument. Therefore, formal logic as a theoretical system of arguments merely captures the formal means by which "statements of such and such a sort imply statements of such and such other sort" (Harman, 1986: 4). Thereby, the rules of formal logic, for him, function as "constraints on what structures count as formal arguments" within the deductive system in question (Harman, 2009: 1). So, formal logic, as Harman argues, merely sets normative means about how to deduce 'Q', for instance, from 'P' and 'P V Q' together. At this juncture, Harman further claims that the rules of formal logic such as *modus ponens* function as schematic norms for valid deductions. Such a stance on formal logic indicates a certain feature of logic in its manifestations in the tokens of informal reasoning, namely that formal logic is schematically instrumental to the practice of informal reasoning in the sense that the rules of formal logic universally and schematically hold irrespective of what natural language statements are employed to follow such a formal deductive system of proof. So, such an instrumentalist approach also suggests that the rules of formal logic also hold irrespective of what psychological attitudes can be directed towards the content of these statements in the tokens of informal reasoning (Harman, 2002). To illustrate, formal logic in this instrumentalist sense excludes the question of whether any rational agent has an interest in or disposition about inferring the statement 'C' from the statements 'B' and 'A' that express irrelevant propositions for her current interests or dispositions. On the other hand, formal logic, in its schematic form and deductive role, can merely indicate whether 'B' and 'A' together imply 'C' through any formal deductive rule axiomatized in the adopted system of proof. In this context, Harman rigorously emphasizes

that a token of formal deductive reasoning is topic-neutral while it is definitive for the formal rules of logic that they hold universally and schematically without exception in the given formal system of argument. So, the inference 'Q', for instance, always follows from 'P' and 'P→Q' independently of what semantic content -i.e. truth-conditions- or natural language counterparts these terms might have as long as these terms stand for well-formed sentences in the given system of proof. Thus, Harman's instrumentalist projection on the topic-neutrality of formal logic accordingly implicates that the valid tokens of formal logical deductions are indefeasible in the sense that the conclusion 'Q', for instance, cannot be withdrawn once endorsed that 'P' and 'P→Q' (1984: 107-110). Put differently, a formal deductive closure cannot allow for revisions or retractions in given valid tokens of logical inferences.

In this respect, Harman, from some instrumentalist point of view, points out that topic neutrality and indefeasibility are interrelated and definitive characteristics of formal logic to the effect that tokens of informal reasoning cannot definitively carry out these characteristics. Consequently, Harman argues that the standard view fails since it seeks to pair two incompatible systems of deduction none of which can boil down into another in the face of their definitive characteristics. To explicate, Harman initially underlines that informal reasoning definitively involves inferential processes in which rational agents employ their thoughts, beliefs, and intentions to ground some others in a revisable manner (1986, 2002). In this vein, he thereby adopts that any token of informal reasoning categorically stands for "reasoned change in view" (1986: 4). To explicate his notion of informal reasoning, imagine that one customer enters a burger place with an intention to order a full burger meal with sides just because she believes that she will actualize her intention if she takes the act of ordering as she initially intended. Suppose further that she suddenly feels sick because of some stingy smell lingering in the burger place. Thereby, she might fairly give up her belief that she will have a full burger meal with sides, and she might even come to believe that she will not have anything in that place, and she can settle for something else in some other place. In typical instances of informal reasoning, rational agents might fairly come to change or drop their beliefs and intentions in the very course of their acts of reasoning. From this point of view, tokens of informal reasoning, for Harman, are dynamically revisable. Hence, according to Harman's account of informal reasoning, it dynamically hinges on what agents might come to believe or disbelieve in the discursive course of each token of reasoning. Consequently, tokens of informal reasoning turn out to be defeasible as one belief in a given token of reasoning can be revised or dropped depending on the relevant reasoner's varying intentions and interests under a given context of inference. To wrap up, Harman contends that informal reasoning, unlike formal logic, allows topic dependence and defeasibility in inferential processes.

Provided that the tokens of informal reasoning do not harbor some definitive characteristics of the tokens of formal deductions in logic, Harman claims that tokens of informal reasoning, which stands for revisable and topic-dependent processes within intentional contexts, cannot be safely modeled after formal logical deductions which stand for topic-neutral and indefeasible processes within universal and schematic discourse. To prove his point, Harman enlists some illustrative cases about how informal reasoning becomes irreconcilable with formal logic in terms of topic neutrality and indefeasibility (1986: 11-20; 2002: 172-176). To capture the gist of these cases, it is better to outline an argument for his stance on the irreconcilability between formal logic and informal reasoning in virtue of the diverging features mentioned above. For Harman, the logical rule of *modus ponens*, for instance, simply suggests that one must infer 'Q' if 'P' and 'P→Q' hold if it has any normative relevance to informal reasoning. Hence, if informal reasoning obtains this formal principle from classical deductive logic, then this principle must be legitimately construed as follows: if an agent believes 'P' and 'P→Q' then she ought to infer and believe 'Q'. Nonetheless, such a construal of formal deductive principle, for him, cannot be legitimate since it fails to capture the true character of informal reasoning for four reasons.

For one thing, a rational agent in the process of informal deduction does not have to recognize that 'P' and 'P→Q' logically implicate 'Q' even if she believes both 'P' and 'P→Q'. In this sense, she might not have or acquire any conceivable reason to infer and believe 'Q' even when she holds the beliefs 'P' and 'P→Q'. To illustrate, the customer in our early example above might believe that she will order a full burger meal in the burger place and that she will enjoy having it in the burger place if she will order a full burger meal there, and yet she does not have to realize that these two beliefs imply that she ought to believe that she will enjoy having it. She can fairly hold two beliefs without recognizing what they logically imply together. So, Harman thinks that formal logical

principles do not indispensably guide agents toward a particular line of inferences since agents might have no conceivable interest nor intention to get on this track of formal deduction. After all, an agent's beliefs about some subject matter might be truth-conditionally relevant to each other in numerous ways and thereby this might prompt us to map such beliefs onto numerous formal logical arguments based on the supposed translatability of such truth-conditional relations into formal semantics of classical deductive logic. However, this agent might not conceive of any formalized instance of such truth-conditional relations among her beliefs; better yet, it would be inconceivable for her to track every logical implication of her beliefs just because there might be infinitely many formal logical deductions built by those truth-conditionally related beliefs under the relevant formal rules of implication. In this respect, Harman seems to bring out a plausible case that rational agents in their tokens of informal reasoning do not have to realize every logical implication that can be formally derived from their beliefs.

Apart from this, Harman points out a further reason why formal logic cannot govern informal reasoning. As he suggests, a rational agent does not have to come to believe whatever is logically implicated by her beliefs even if she conceives of what logical implication(s) her beliefs such as 'P' and 'P→Q' carry out. For instance, a logically implicated belief such as 'Q' might simply be unacceptable for the agent for some conceivable reason to the effect that she might even give up her beliefs 'P' and/or 'P→Q' which logically implicate 'Q' together. Drawing on our last example, the customer may fairly conceive that her beliefs logically imply that she will enjoy having the full burger meal in the burger place, but this might turn out to be an unacceptable or untenable belief to commit because of some changes in the given conditions of her belief. So, the customer might fairly give up her belief that she will enjoy having the full burger meal in the burger place if she, for instance, feels detested by the stingy smell in the burger place or it turns out that the burger place ran out of the side snacks coming with the full meal. In such cases, she may give up her belief for one reason or another which leads her to disbelieve that she will have the full burger meal in the burger place. Nonetheless, she may still recognize that the belief, which she just gave up, logically follows from her some other beliefs before the recent changes in the given conditions. Considering such cases derived from informal reasoning, Harman concludes that each inferential step in a token of informal reasoning is defeasible or cancelable in contrast to the case that inferential steps inescapably adhere with each other in formal logical deductions through the rules of implication. Thus, premises in tokens of informal reasoning do not universally stand in the cursive acts of inferences.

Respectively, Harman extends his earlier points and proposes one more reason why informal reasoning cannot be boiled down into formal logic. For him, it is feasible to assume cases where rational agents conceive of the formal equivalences and logical implications of their beliefs while they also find them acceptable or tenable to believe. Even under such an assumption, those rational agents may still have no conceivable interest in believing these logically implicated beliefs. For one thing, rational agents may find them to be trivial consequences of their subsequent beliefs and thereby they may not have any isolated motivation to believe in them further. Such implications, as Harman indicates, do not have to overlap with nor govern rational agents' interests in a relevant token of informal reasoning. Thus, the rules of formal logic have no effect or role in grounding and guiding agents' argumentative interests in a given token of informal reasoning in the sense that formal logic does not ground why and how an agent shows an interest or a certain psychological attitude about some belief that she does not prefer to make use of in an inference.

As a final reason for rejecting the main thesis of the standard view, Harman emphasizes one absurd consequence of endorsing the standard view: if rational agents ought to believe 'Q' just because it is conceivably implied by their previously held beliefs such as 'P' and 'P→Q' then they ought to believe every logical implication of their beliefs such as 'P V Q', 'P V P', ' (P V Q) →Q' and so on. Such a consequence of the standard view is implausible once noticed that such trivially implicated beliefs are infinitely many to conceive for rational agents who naturally have practical interests and restrictions in making inferences with full disclosure at a conscious level. Better yet, rational agents are of finite computational capacities and interests, which is why rational agents never intend to and manage to compute an infinite string of trivially implicated beliefs to come up with an inference. Regarding the absurdity of the standard view in the above sense, Harman once again concludes that it would be a mistake to hold that formal logic- along with its formal structure, principles, and theory of proof- normatively governs how rational agents ought to reason in given tokens of informal reasoning.

To wrap up, Harman advocates that formal logic has no descriptive nor normative relevance to informal reasoning. In this respect, formal logic, as he argues, stands for a formal deductive system marked by being topic-neutral and indefeasible which in turn simply accounts for how one well-formed formula logically implies another based on the given formal semantics (i.e. the rules of logical implication) and the given theory of proof. In this respect, he considers formal logic as an irrelevant apparatus for representing tokens of informal reasoning – which corresponds to revisable or defeasible inferences where rational agents identifiably entertain topic-dependent, practical, and psychological dispositions. To put it simply, formal logic becomes irrelevant to informal reasoning since they have irreconcilable characteristics to be paired with each other. On the other hand, it is worth noticing that Harman's critique of the standard view merely underlines the irreconcilability between classical deductive logic and informal reasoning. Nonetheless, such a case for irreconcilability does not amount to a claim that there can never be a sort of formal logic whose inferential characteristics jibe with informal reasoning along with its characteristics. Here, Harman partially answers the question of whether there might be another sort of formal system of proof that governs how we informally reason in a revisable and dynamic manner. Even if it is true that classical deductive logic does not ground how we do or ought to reason, it does not exhaust the possibility that there could be some other formal system suitable with the defeasible and topic-dependent nature of informal reasoning. Therefore, Harman's objections to the standard view -intentionally or unintentionally -omit logical pluralism as if there must be only one complete formal system of proof that is eligibly relatable with informal reasoning. In this regard, one might argue that there may be non-classical and non-deductive systems of logic with which informal reasoning can comply. In that case, a proponent of the standard view might still argue that such formal systems govern how a rational agent ought to reason in her token of reasoning. Of course, such a system of logic conforms with Harman's account of informal reasoning only if the formal rules of such a system- along with its proof-theoretical features such as validity, completeness, and so on- capture the dynamic nature of belief revision. So, Harman's objections, at best, function to delimit the standard view by disposing of classical deductive logic due to its irreconcilability with informal reasoning.

4. Conclusion

In logic and philosophy, the standard view on the relevance between formal logic and our everyday reasoning austerely contends that formal logic governs informal reasoning. The standard view can be fairly interpreted in a descriptive sense and normative sense. According to the former, the standard view is a psychological thesis on how we spontaneously reflect in our everyday tokens of informal reasoning so that the rules of formal deductive logic categorically govern our everyday reasoning in its natural state. The latter interpretation, however, posits that formal logic as a formal system of proof normatively governs informal reasoning in the sense that we ought to reason by means of the rules of formal logic if we are to reason ideally in our tokens of everyday reasoning. Once rationality and rational agency are portrayed as agents' capacity for following the ways of reasoning correctly at a conscious level, then the standard view further implies that rationality boils down to compliance with formal logic.

As discussed earlier, the standard view has been seriously challenged both in cognitive science and logic. Respectively, Wason's *selection task* seeks to undermine the plausibility of the standard view so that rationality or rational agency does not strictly thrive on having a capacity for reasoning with formal logic. As the selection task and its variants indicate, agents – spontaneously or inadvertently- have a propensity for not employing some formal rule of logic that seems to be salient and relevant in their given token of reasoning. In addition, Gilbert Harman (1984, 1986, 2002, 2009) independently argues that formal logic has no normative relevance to informal reasoning. For him, the rules governing informal reasoning cannot be exhausted by the rules of formal deductive logic since they have irreconcilable characteristics in their procedural discourse.

Although I will not thoroughly discuss the plausibility of logical pluralism, I mean to point out that the above objections against the standard view omit that there may be some other sort of formal system that inherits the characteristics of being defeasible and being topic dependent. If we endorse formal logic as a formal theory of deduction characterized by three constitutive parameters- i.e. formal syntax, semantics for the formal language, and a definition of validity conditions for them- then we might seek to construct a formal system that mimics informal reasoning by adjusting its constitutive parameters to the various tokens of informal reasoning.

Accordingly, a formal system of deduction can be diversified based on how we coherently construct these three parameters with different sets of formal language, rules of deduction, and validity conditions. Thus, endorsing logical pluralism weakens the above objections against the standard view to the effect that they at best contend that rational agents do not ideally reason with classical deductive logic. Even though the plausibility of logical pluralism is contentious in its own merits, it is still worth indicating that these objections against the standard view-deliberately or not- come with an extremely limited scope of analysis. Hereby they do not satisfactorily disaffirm every possible formal system of proof in terms of their normative or descriptive relevance to informal reasoning. Such objections only provide a very narrow scope designated to cover the classical deductive logic and the cases of practical reasoning fully propositional at the conscious level. In this regard, the objections above, if they are cogent, ultimately refute nothing other than the restricted thesis that the first-order deductive logic governs informal reasoning in its every sort of token. Contrapositively speaking, these objections at best leave room for the thesis that a non-classical system of logic has a descriptive or normative relevance to informal reasoning.

BIBLIOGRAPHY

Engel, P. (2006). Logic, Reasoning and the Logical Constants. Croatian Journal of Philosophy, 6 (2):219-235.

Evans, J. S. B. T. (2002). "Logic and Human Reasoning: An Assessment of the Deduction Paradigm", *Psychological Bulletin*, 128(6), 978–996.

Caret, C. R., & Kissel, T. K. (2020). "Pluralistic Perspectives on Logic: An introduction", *Synthese*, 1-12.

Harman, G. (1984). "Logic and Reasoning", *Synthese*, 107-127.

Harman, G. (1986). *Change in View: Principles of Reasoning*, Cambridge, Mass.: MIT Press.

Harman, G. (2002). "Internal Critique: A Logic is not a Theory of Reasoning and a Theory of Reasoning is not a

Logic", *Handbook of the Logic of Argument and Inference: The Turn Towards the Practical,* (Eds: D.M.Gabbay et al), 171-186.

Harman, G. (2009). "Field on the Normative Role of Logic", *Proceedings of the Aristotelian Society,109*, 333-335.

Novaes, C. D. (2012). *Formal Languages in Logic: A Philosophical and Cognitive Analysis*, Cambridge: Cambridge University Press

Samuels, R. & Stich, S. (2004). "Rationality and Psychology", *The Oxford Handbook of Rationality* (Eds: Al Mele and Piers Rawling), 280-300, Oxford University Press.

Stenning, K. & Lambalgen, M. v. (2008). *Human Reasoning and Cognitive Science*. Cambridge, Mass.: MIT Press.

Sider, T. (2009). *Logic for Philosophy*. New York: Oxford University Press.

Wason, P. (1966). "Reasoning", *New Horizons in Psychology* (Ed: B. Foss), 135-151, Penguin Books.

Wason, P. C., & Green, D. W. (1984). "Reasoning and Mental Representation", *The Quarterly Journal of Experimental Psychology A*: Human Experimental Psychology, 36A (4), 597–610.

Wason, P. C., & Shapiro, D. (1971). "Natural and Contrived Experience in a Reasoning Problem", *The Quarterly Journal of Experimental Psychology, 23*(1), 63–71.

Wittgenstein, L. (1961). *Tractatus Logico-Philosophicus*. Routledge.

Woodcox, A. (2022). "Logikôs Argumentation in Aristotle's Natural Science", *Apeiron, 55 (1*), 65-95.

Zingano, M. (2017). "Ways of Proving in Aristotle", *Reading Aristotle: Argument and Exposition, 146*, 7-49.

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