

An Argumentative Approach to the Justification of Abduction

PAULA OLMOS

Universidad Autónoma de Madrid

paula.olmos@uam.es

The philosophical debate over the justification of abduction can be modelled as the critical assessment a *warrant-establishing argument* allowing “H explains D” to be used as a reason for “H can be inferred from D”. Philosophers discuss conditions under which such kind of generic argument could be accepted. Five kinds of conditions are identified and commented on: a) dialectical/procedural restriction; b) claim restriction; c) restriction over acceptable explanatory principles; e) balancing restriction and d) epistemic restriction.

KEYWORDS: abduction, backing, explanation, inference to the best explanation, justification, metaphilosophy, Toulmin model, warrant.

1. INTRODUCTION. PHILOSOPHY AS A CASE-MAKING ACTIVITY

This paper is an essay on *metaphilosophy* inasmuch as it tries to review, describe and categorise different ways philosophers have approached a certain self-assumed philosophical task. In our case, this task is the justification of a certain mode of reasoning and arguing, namely abduction. Such a kind of endeavour responds to a tradition which has been mainly represented by the well-known and long-standing philosophical discussion on the “justification of induction”.

Our inquiry is, in any case, presided by the assumption that what philosophers mainly do is arguing. So the idea is to approach their pursuit as an *argumentative activity* and, more specifically, under a conception of arguing and argument that does not aim at capturing what *follows from* what, of what *is implied* by what, but tries instead to understand how something (some content) is presented/proposed by someone to others as a reason for something else in a communicative setting (Marraud 2013).

This idea of philosophy, not only as an argumentative activity but, more specifically, a kind of *case-making* activity under the model of legal discussion was already proposed by Friedrich Waismann in his definitely metaphilosophical and influential paper “How I See Philosophy” (1968 [1956]).

The essential difference between philosophy and logic is that logic constrains us while philosophy leaves us free: in a philosophic discussion we are led, step by step, to change our angle of vision [...] a thing profoundly different from deducing theorems from a given set of premisses (Waismann, 1968 [1956], p. 21)

[philosophical arguments] were, quite mistakenly as I hope to have shown, supposed to be proofs and refutations in a strict sense. But what the philosopher does is something else. He builds up a case. First, he makes you see all the weaknesses, disadvantages, shortcomings of a position; he brings to light inconsistencies in it or points out how unnatural some of the ideas underlying the whole theory are by pushing them to their farthest consequences [...] On the other hand, he offers you a new way of looking at things not exposed to those objections. In other words, he submits to you, like a barrister, all the facts of his case, and you are in the position of a judge (Waismann, 1968 [1956], p. 30).

But one interesting twist is that philosophy is a case-making or reason-giving activity that is particularly interested on *other* case-making (reason-giving) activities: from the most ordinary and universal to the most sophisticated and heavily institutionalized ones. Thus, Jonathan L. Cohen goes as far as characterizing philosophy as “the reasoned investigation of reasons” or “the reasoned discussion of what can be a reason for what” (Cohen, 1986, pp. 49–50, 57). This last remark fits exactly a discussion as that of the “justification of abduction” in just the way we are going to reconstruct it.

On the other hand, it should not be disregarded that, precisely in our case, the philosophical interest in the justification of abduction has been particularly encouraged by its centrality for discussions regarding science and its own methods *within* philosophy of science (Olmos, 2018a). Although John Woods’s paper on the *logic of abduction* (2016) aims at a more general, epistemological, picture of what is for him basically a naturalistically (evolutionarily) developed mode of reasoning, he must nevertheless deal with the nature of scientific enquiry and its own justificatory standards. It is in this regard that he offers us a usefully *argumentative* characterization of science itself, another *forensic*, case-making (communicatively reason-giving) activity:

Not unlike the law, science is in significant measure a case-making profession –a *forensic* profession– made so by the premium it places on demonstrating that knowledge has been achieved, rather than just achieving it. This has something to do with its status as a profession, subject to its own exacting requirements for apprenticeship, standard practice, and advancement. These are factors that impose on people in the showing professions expectations that regulate public announcement. [...] Publication is a vehicle for case-making, and case-making is harder than knowing. Journal editors don't give a toss for what you know. But they might sit up and notice if you can show what you know (Woods, 2016, 143-144).

So the philosophical justification of abduction deserves a *doubly* argumentative approach: as an argumentative activity dealing with another argumentative activity. If I now reveal that I favour what's usually dubbed as a *first-order construal* of metaphilosophy for which “the application of philosophy to philosophy itself, is simply one more instance of philosophy” (Joll, 2017; Cf. Wittgenstein, *PI*-§121; Cf. Williamson, 2007, p. ix), it is clear that the reader of this paper is dealing with no less than *three* argumentative layers which should, on the one hand, be clearly distinguishable and, on the other, be understood and dealt with the *same* practical and conceptual tools.¹

Keeping this in mind, section 2 will just try to clarify, for the purposes of the present discussion, my own argumentative account of abductive argument, as developed in previous papers (Olmos 2019a; 2019b; forthcoming). Section 3 will show different argumentative ways philosophers have essayed for the global justification of abduction, some of which (3.1, 3.2, 3.3, 3.4) simply demand restrictions compatible with the current critical assessment of particular abductive arguments, while others (3.5) try to reach a deeper level in which the very grounds of “what constitutes a reason for what” are directly confronted.

Finally, some conclusions about the nature of these discussions are offered in section 4.

2. ARGUMENTATIVE APPROACHES TO ABDUCTION²

¹ This is not necessarily so, as philosophy could claim to use different methods or argumentatively distinct strategies and grounds. However, although this cannot be dealt with here, my contention is that there is nothing fundamentally diverse in philosophical argument.

² This section is based on previous work (Olmos, 2019a, 2019b, forthcoming). Concrete quotations won't be indicated in the body of text.

Since D. Walton's extensive monographic work (Walton, 2004) there have been some distinct argumentative approaches to abduction. Probably not as many as could be expected but certainly covering different trends within argumentation theory. Walton's work is based on the methodology of "dialogue types", offering both a "dialogical model of explanation" plus a "dialogical model of justification of best explanation" (which is, for him, equivalent to abduction). Wagemans's approach (2016) is pragma-dialectical and Yu & Zenker (2018) employ a methodology of argumentation schemes plus critical questions.

My own proposal offers a model of abduction based on a distinctly Toulminian argumentation scheme (in which the role of the warrant is duly emphasized), supplemented with some analytic tools accounting for *inter*, *counter*, and *meta-argumentative* structures.³ According to this framework, presenting in a communicative interchange an abductive argument is to support an in principle theoretical or factual claim (typically mentioning either unobservable or merely unobserved entities, properties and processes) on the basis of shared data (typically observable, well-known, taken for granted or assumed) *precisely because* it provides some conceivable explanation to them. The basic elements of an abductive argument, thus understood are:

1. **Conclusion/Claim:** an "explanatory hypothesis" H, usually presented as a factual statement, although, depending on the requirements of the context it may be easily reinterpreted as a practical or even evaluative conclusion of the kind: "we should explore hypothesis H", "Hypothesis H is worth exploring".
2. **Reasons/Data:** usually empirical, observable but in any case presented as *shared* or *agreed upon* data, and nevertheless *surprising data*, i.e. data *requiring explanation* (what makes of them a potential *explanandum*). However this preparatory condition might be contested in an ensuing discussion.
3. **Warrant:** what makes of the data a justificatory reason for the conclusion (the hypothesis) is that such hypothesis *could explain* them.

³ These tools are best described in a series of papers by H. Marraud's: Cf. <https://uam.academia.edu/hubertmarraud>.

These elements may be represented thus:

Warrant: Hypothesis could explain data	Data: Shared (usually empirical) data
	So
	Claim: Hypothesis

In the case of abductive arguments, it could seem as though the kind of warrant I am proposing is not exactly “of a more general scope” than the data and claim of the argument, referring exactly to the same items as its basic constituents. Nevertheless, this is just apparently so as such a warrant introduces between these items a *substantive kind of relation*, namely “explanation”, which responds as well to a variety of *principles* or *explanatory warrants* on which it may be based. The concretion of the type of *explanans* that the Hypothesis is vis-à-vis the Data (taken as *explanandum*) provides the degree of *principled generality* that an argument requires to be so recognized and understood (and eventually assessed) by an interlocutor.

According to this idea and taking in account the structural homogeneity of argument and explanation as the products of pragmatically different *acts of giving reasons* (Álvarez, 2016) it is possible (and useful) to construe an “expanded diagram” of abduction, including the details of the *related* explanation –an explanation that is not exactly *given* in the abductive argumentative act but just, *mentioned* or *alluded to* as what makes of the empirical data a justificatory reason for the (theoretical) hypothesis– thus:

In virtue of explanatory principle/ideal X:		Empirical data
	Hypothesis	So
	That’s why	
	Data	
		Explanatory hypothesis

However, argumentative models of abduction are not really my topic in this paper. All these models, in fact, assume both the widespread presence of abductive arguments in a variety of argumentative practices and their *evaluable character*, proceeding then to determine ways in which abductive arguments are in fact or should be assessed.

But these conditions are precisely the nub of what is *at stake* in philosophical discussions about the justification of abduction. At least in principle, although, depending on the particular solution provided they are questioned to a greater or lesser degree.

3. PHILOSOPHICAL DISCUSSIONS ON THE JUSTIFICATION OF ABDUCTION

So, the idea of philosophical discussion on the justification of abduction is to discuss *the grounds themselves* that allows for the understanding, conception and presentation of abductive arguments. Using Toulminian terminology, they would discuss *up to what point* the kind of (substantive) link between data and claim invoked in an abductive argument (i.e. expressed in its warrant) makes of the data a justifying reason for that claim. Thus, such philosophical debates might be considered as *warrant-discussing* argumentative activities aiming at *establishing warrants* (or warrant-types, Cf. Toulmin, 2003 [1958], 111-113, 125-126).

According to these ideas, philosophical discussions on the justification of abduction might be modelled as constituting an, either restricted or more radical but, in any case, reasoned (and argumentative) *critical assessment* of the following scheme in which “H explains D” (or “H, that’s why D”) is taken as a reason to support that “D justify H” (or “D, so H”):

Warrant: That a hypothesis explains some data is a reason to consider those data a justifying reason for that hypothesis:

Reason: Hypothesis explains Data

So

Claim: Data justify Hypothesis [Hypothesis can be inferred from Data]

For the purposes of my discussion, I will, in fact, be using *more expanded* versions of this same scheme as the following:

That a hypothesis explains some data is a reason to consider those data a justifying reason for that hypothesis:

Hypothesis

That’s why

Data

So

Data

So

Hypothesis

In virtue of “explanatory principle X”:	Hypothesis
	That’s why
	Data

That a hypothesis explains some data is a reason to consider those data a justifying reason for that hypothesis:

So

Hypothesis can be inferred from Data

Now, if you ask, *what kind of reason* could that one be for such a claim? the answer should be expressed by the warrant I have provided which is, I must agree, *frustratingly redundant*, and so kind of useless. It might be considered (taking in account how it is articulated) a “more general” statement than the argument it covers, but it surely does not add any new substance to it, beyond formal or informal *subsumption* (depending on quantification).

This is a problem according to my own reading of Toulmin’s warrants.⁴ However, I will advance two excuses for it. The first is that we might be reaching a really deep (cognitive, logical) level of what counts as a reason, not really based on more reasons-for-*reason-being* than sheer “intuition”. But, this is really what is *at stake* and what some philosophers (as those mentioned in 3.5) will really try to handle by suggesting “backings” for such a rule.

The other excuse is simply operative. Such a scheme (as will be shown in what follows) makes room for both the philosophically deeper and the more *accommodating* (and qualified) restrictions on the use and acceptability of abductive arguments that different authors have supplied and is, therefore, a good instrument to compare them.

Now, philosophers such as J. Woods, I. Hacking, P. Lipton, B. van Fraassen or I. Douven (many of them interested in attacking or defending “scientific realism”) have discussed abduction starting with the idea that it is not a mode of reasoning and arguing that could be unqualifiedly or unrestrictedly admissible. So their strategy is demanding additional restrictions or well-defined conditions under which such kind of generic scheme (and therefore, the particular abductive arguments generated by it) could be accepted.

Five such modes or levels of restriction might be identified in philosophical literature and will be described in the following subsections.

⁴ See, my Commentary on J.A. Blair’s paper in these same *Proceedings*.

3.1 Global dialectical/procedural restriction (or field limitation)

The generic scheme and so the use of abductive arguments might be admissible in some argumentative fields while not in others: e.g. it is all right to use abductive arguments in everyday life but not in scientific inquiry. Such global restrictions are usually made dependent on considerations regarding:

- i) The higher or lower degree of certainty demanded from proofs in that field.
- ii) The greater or lesser need (or institutional obligation) to reach a conclusion.

Both kinds of considerations obviously act in opposite directions as to the admission of abductive arguments. B. van Fraassen's contention about the non-scientific character (because they go beyond empiricism) of conclusions based on abduction is a good example of this:

A person may believe that a certain theory is true and explain that he does so, for instance, because it is the best explanation he has of the facts or because it gives him the most satisfying world picture. This does not make him irrational, but I take it to be part of empiricism to disdain such reasons (van Fraassen, 1985, 252).

3.2 Claim restriction (related to the argument's sufficiency)

The generic scheme and so the use of abductive arguments might be admissible adjusting the *mode of validity* of its claim (or the kind of claim presented by its conclusion). In his paper on the logic of abduction, J. Woods emphasizes what he sees as one of the Peirce's insights: "Rather than believing them, the proper thing to do with abducted hypotheses is to send them off to experimental trial. (CP, 5. 599, 6. 469-6. 473, 7. 202-219)" (Woods, 2016, 138). According to this idea, abduction may not really provide reasons (enough? any?) to assert the hypothesis but may function as a directive "practical argument" in the following way:

In virtue of “explanatory principle X”:	Hypothesis
	That’s why
	Data

That a hypothesis explains some data is a reason to consider those data a justifying reason to **experimentally test** such hypothesis:

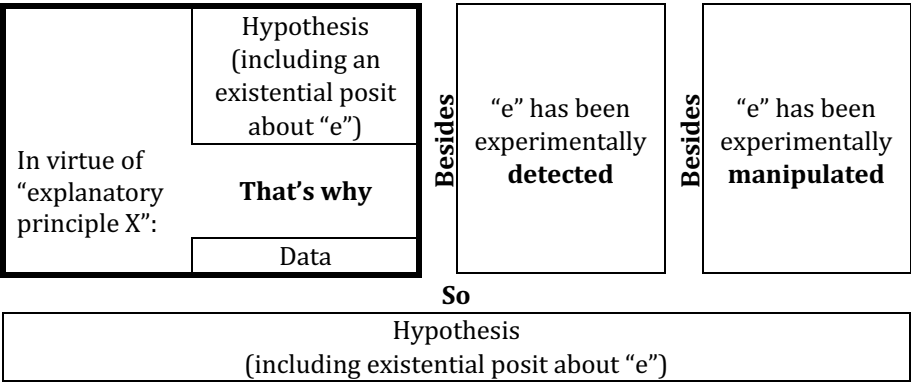
So

Data
So
Hypothesis should be empirically tested

Now, using similar intuitions, I. Hacking, in *Representing and Intervening* (1983: 271-272) mentions the *insufficiency* of abduction, i.e. of the mere explanatory power of a hypothesis, to support a “realist claim” regarding a theoretical entity (e.g. the electron), included among the posits of that hypothesis. His point is that we are finally justified in supporting such a “realist claim” as a theoretical statement about the entity’s “existence” when our experimental practices have allowed us:

- a) to (directly/indirectly) *detect* the entity, and
- b) to effectively *manipulate* it in further experiments *unrelated* to its establishment (Cf. Douven 2002, 360-362).

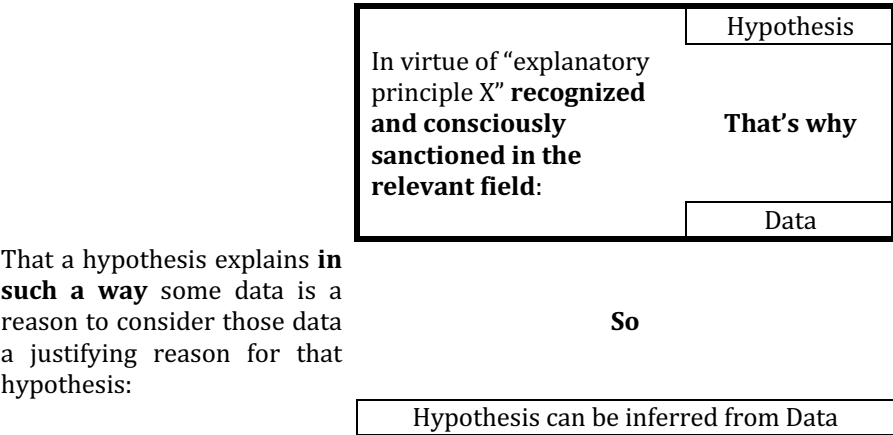
Hacking’s suggestion might be argumentatively modelled as requiring for the sought for conclusion (the assertion of the hypothesis) a *conjunction of arguments* (Marraud, 2013, p. 59-62; Cf. Olmos, 2018b, p. 23) which functions as a *coordinative argumentation* (Snoeck-Henkemans, 2003).



3.3 Restriction over acceptable explanatory principles

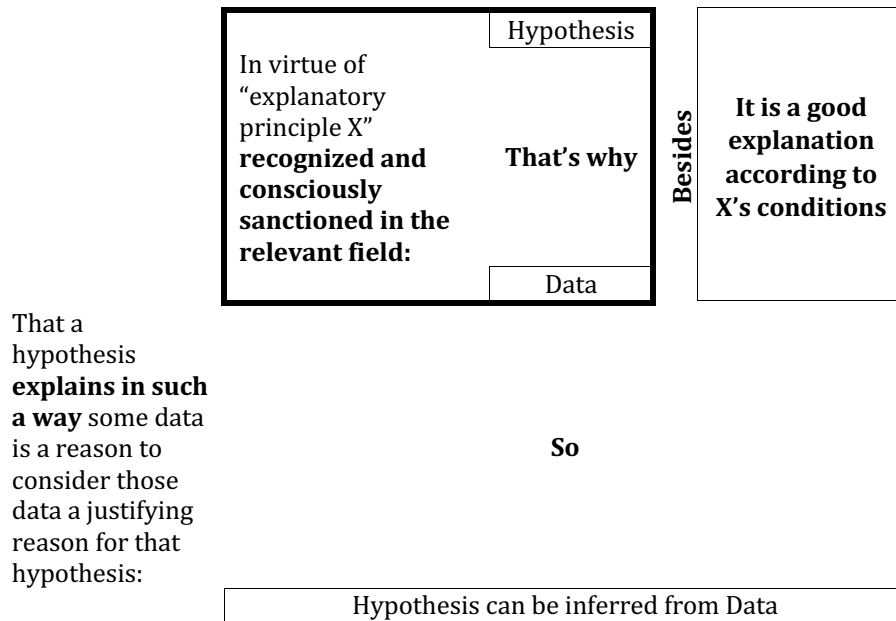
A different kind of discussion arises when one concentrates on the idea that explanations, as arguments, may also be classified according to the diverse kinds of “explanatory warrants” they are based on. A possible answer to the admissibility of abduction makes it dependent on the kind of associated explanation that serves as its warrant. In this sense, the generic abductive scheme and so the use of abductive arguments might be admissible just in case some normative requirements are placed on it regarding three different aspects.

- a) A restriction over the *kinds* of explanation (or explanatory principles) acceptable in a given field.⁵ This restriction might be added to the diagram of an acceptable abduction, thus:

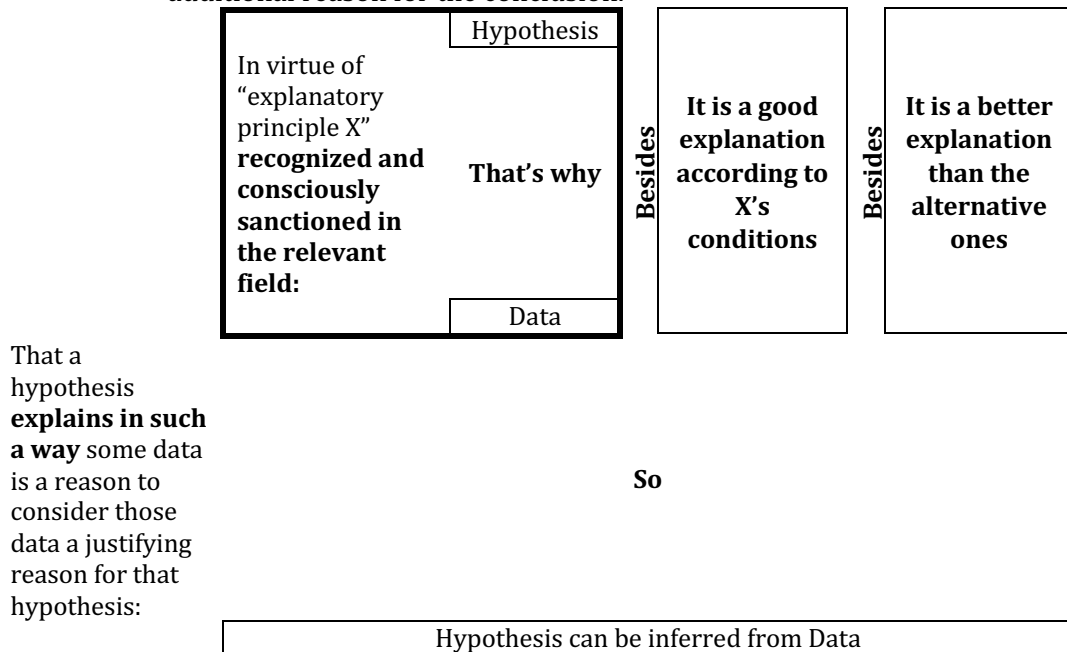


⁵ This is usually what’s at stake in contemporary philosophical discussions on the notion of “mechanism” as what may be the basis of a scientific explanation (Glennan & Illari, 2016).

- b) A restriction over the *quality* of such an explanation, based on standardized criteria associated to the “explanatory principle” in case. Here what would really be the conclusion of a process of critical assessment of the explanation is represented as an additional reinforcing reason.



- c) Finally, a further restriction could be called for regarding the *comparative quality* of the explanation *vis à vis* other alternative explanations. Here, again, what would really be the conclusion of a more complex argumentative process is represented as just an additional reason for the conclusion.



But the interest of such a justification process in itself has led some philosophers to concentrate on it as what's really the true key to the assessment of abduction which could only be acceptable and even assessable under the model of an "inference to the best explanation". The next kind of restriction in our classification accounts for this idea.

3.4 Balancing restriction (stipulation of comparative weighing)

Philosophers such as I. Douven (2017) consider abduction is only justifiable under an IBE model. That means that emphasis is placed over the justification of the comparative premise: "It is a better explanation than the alternative ones".

Now, according to my own analysis (Olmos 2019b) this implies the systematic weighing of the arguments supporting each alternative explanatory hypothesis which of course can be very different and based on different warrants. Thus, my claim is that there cannot be a rigid universal model of IBE-type argumentations. In any case, among the simplest (and probably most interesting) possibilities is the comparison between two abductive arguments (supporting each an alternative

explanatory hypothesis) based on the superiority of one of the explanatory principles invoked over the other. This could be thus represented:

Explanatory principle X is superior to explanatory principle Y (in the relevant field)				
So				
In virtue of explanatory principle X:	Explanatory Hypothesis A		Explanatory Hypothesis B	In virtue of explanatory principle Y:
	That's why	>	That's why	
	Empirical data		Empirical data	
So				
Hypothesis A offers a better explanation than Hypothesis B				

3.5 Epistemic restriction (or backing-request)

So far, the ideas advanced by different authors for a qualified acceptance of abduction as a *prima facie* plausible and assessable mode of arguing, even if conducted in a universal and allegedly conceptual way, do not really go much beyond the *usual* criteria we are accustomed to in assessing *particular* abductions as establishing stronger or weaker arguments. Thus, the critical questions usually associated with abduction as an argumentative scheme (Cf. Marraud, 2017, p. 5) may easily take care of requirements such as those expressed in 3.1 (usability of the scheme in a certain context), 3.3 (grounds and quality of the associated explanation) and 3.4 (comparison of claimed hypothesis with alternative hypotheses). So, finally, what these kinds of (philosophical) restrictions really amount to is the acceptability of *good-enough* abductions.

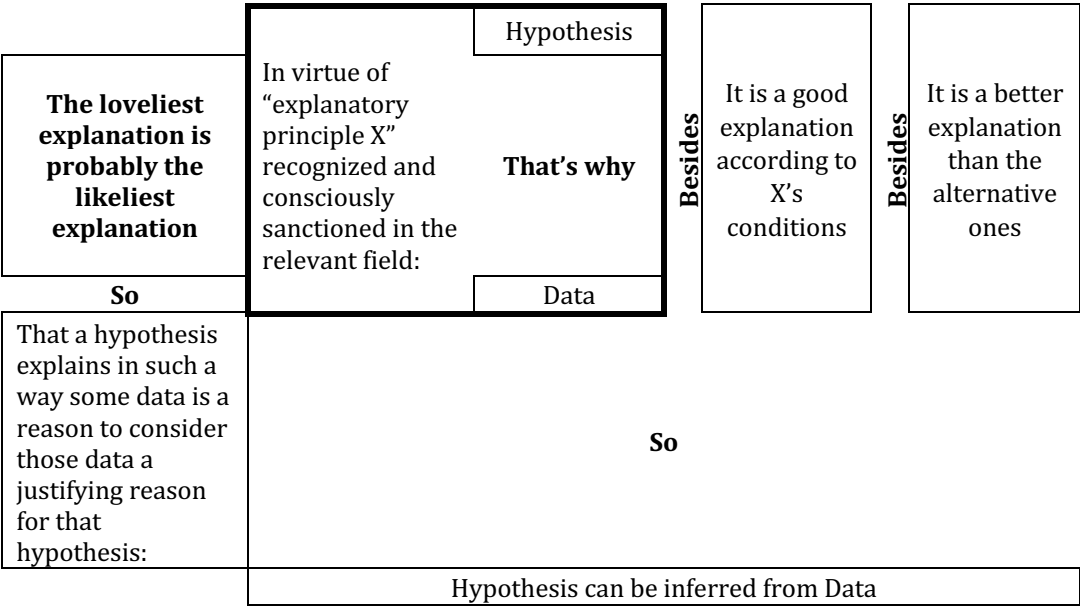
Concerns expressed in 3.2 are probably harder to accommodate in such a methodology, as they address the very definition and comprehension of abduction itself as a theoretically or pragmatically bounded (and accordingly evaluated) way reasoning and arguing. But still, the abductive *principle* is taken for granted.

This is not the case with discussions attaining precisely the *tenability* of the principle itself as an epistemic⁶ rule (i.e.: that a hypothesis explains some data is a reason to consider those data a

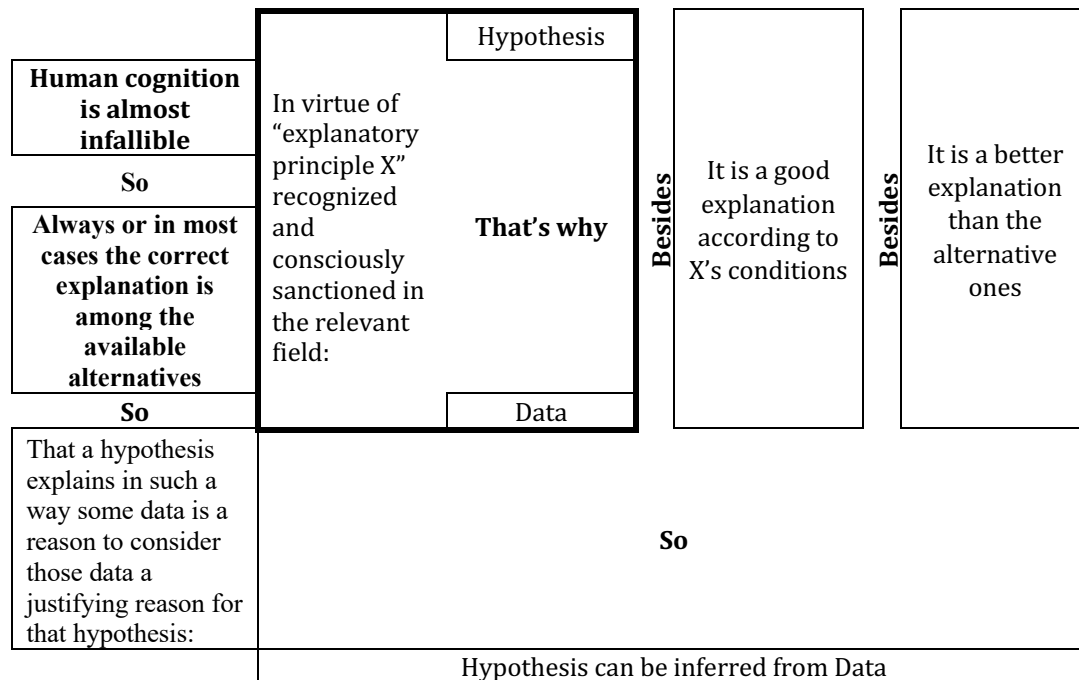
⁶ The terms and context of such a discussion need not be focused on purely “epistemic” concerns, but in fact this is what we mainly find in philosophical literature.

justifying reason for that hypothesis). If we question a principle acting as a warrant (not its limits or scope, but the principle itself) the answer would be an attempt to “back” it, find reasons in its favor. That’s what P. Lipton (1991, 1993), or B. van Fraassen (1989) try to do, albeit adducing really opposite intuitions (cf. Douven 2002, 356-360) and philosophical agendas.

Lipton (who wants to defend the justification of abduction and the feasibility of scientific realism) enunciates an *optimistic* “epistemic principle” as the appropriate backing for our warrant: “the loveliest explanation is probably the likeliest explanation”. It is somewhat redundant but makes explicit the kind of hopeful belief behind our abductive behavior.



Van Fraassen, instead, (who wants to attack abduction, precisely as the *lifeboat* of “scientific realism”) states that the principle could only be established by a rather more polemical epistemic hope: “always or in most cases the correct explanation is among the available alternatives” which, in turn, could only be justified in case “human cognition be almost infallible”. Which is obviously something quite difficult to swallow.



4. CONCLUSIONS

In this paper, I have tried to analyze and categorize, from an argumentative point of view, diverse philosophical approaches and responses to the perceived problem of the justification of abduction.

Part of my interest in this inquiry is to expose not just the argumentative character of philosophical practice (which is a rather widespread assumption) but more precisely its *ordinary* argumentative character, at least in *structural* terms. Philosophical argumentation might be understood and modelled with the same *structural tools* we use to address any other kind of argumentative practice and it is not necessarily more sophisticated than everyday domestic argumentation in those terms.

It addresses, though, substantive questions that are not ordinarily addressed or probed and this implies concentrating on somehow deeper (*grounding*) levels of argument. That’s where Toulmin’s *distinctions* come to help in characterizing the particularities of philosophical argument. First, there’s the distinction between warrant-using and warrant-establishing arguments, which has proved helpful in modelling and understanding discussions regarding “what can be a reason for what” (Cohen, 1986).

Even more significantly, it is Toulmin's whole strategy in dismantling the "undifferentiated premises *plus* conclusion" model –discriminating the different roles the argument's constituents play and the different ways to question them– that has helped us identify specifically *philosophical* concerns regarding the grounds and principles of principles themselves.

Once the iterative and recursive structure of arguing understood, philosophers' concentration of *backings* (for both justificatory and explanatory warrants) is a salient feature of philosophical argumentative practice.

Thus, our metaphilosophical itinerary ends up with the centrality (or at least usefulness) of argumentative analysis for the three levels I mentioned in the Introduction: i) for that of metaphilosophical practice itself, ii) for philosophical practice iii) and for the practices that are of interest for philosophers.

ACKNOWLEDGEMENTS: This work has been made possible by funds provided by the Spanish Ministry of Science, Innovation and Universities through the Research Project PGC 2018-095941B-100, "Argumentative practices and pragmatics of reasons"

REFERENCES

- Álvarez, M. (2016). Reasons for Action: Justification, Motivation, Explanation. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Spring 2016 Edition).
 URL = <https://plato.stanford.edu/archives/spr2016/entries/reasons-just-vs-expl/>
- Cohen, J.L. (1986). *The Dialogue of Reason: An Analysis of Analytical Philosophy*. Oxford: Clarendon Press.
- Douven, I. (2002). Testing Inference to the Best Explanation. *Synthese*, 130, 355-377.
- Fraassen, B. van (1989). *Laws and Symmetry*. Oxford: Clarendon Press.
- Fraassen, B. van (1985). Empiricism in the Philosophy of Science. In P. Churchland and C. Hooker (Eds.) *Images of Science: Essays on Realism and Empiricism* (pp. 245–308). Chicago: University of Chicago Press.
- Glennan, S. & P. Illari, eds. (2016). *The Routledge Handbook of Mechanisms and Mechanical Philosophy*. Oxford: Routledge.
- Hacking, I. (1996 [1983]). *Representar e intervenir*, trad. de Sergio Martínez. México: Paidós.
- Joll, N. (2017). Metaphilosophy. *Internet Encyclopedia of Philosophy*. URL: <https://www.iep.utm.edu/con-meta/>
- Lipton, P. (1991). *Inference to the Best Explanation*. Londres: Routledge.

- Lipton, P. (1993). Is the best good enough? *Proceedings of the Aristotelian Society*, 93, 89-104
- Marraud, H. (2013). *¿Es lógic@? Análisis y evaluación de argumentos*. Madrid: Cátedra.
- Marraud, H. (2017). *Guia de Campo de Esquemas Argumentativos*. URL: <https://www.academia.edu/>
- Olmos, P. (2018a). La justificación de la abducción en el contexto del debate sobre el realismo científico: una aproximación argumentativa. *ArtefaCToS. Revista de estudios de la ciencia y la tecnología*, 7(2), 35-57.
- Olmos, P. (2018b). Commentary on Bermejo-Luque's The Appraisal of Conductions. In S. Oswald & D. Maillat (Eds.) *Argumentation and Inference: Proceedings of the 2nd European Conference on Argumentation, Fribourg 2017* (Vol. I, pp. 19-27). London: College Publications.
- Olmos, P. (2019a). Un enfoque argumentativo sobre la abducción y sobre la ponderación de hipótesis explicativas. *Theoria* 34(1), 5-30.
- Olmos, P. (2019b). A meta-argumentative approach to abduction and IBE
- Olmos, P. (forthcoming). Abduction and comparative weighing of explanatory hypotheses. An argumentative approach. *Logic Journal of IGPL*.
- Sonoeck-Henkemans, F. (2003) Complex argumentation in a critical discussion. *Argumentation*, 17, 405-419
- Toulmin, S. E. (2003 [1958]). *The uses of argument*. Cambridge: Cambridge University Press.
- Wagemans, J.H.M. (2016). Argumentative Patterns for Justifying Scientific Explanations. *Argumentation* 30(1), 97-108.
- Waismann, F. (1968 [1956]). How I see philosophy. In R. Harré (Ed.), *How I See Philosophy by F. Waismann* (pp. 1-38). London: Palgrave Macmillan.
- Walton, D.N. (2004). *Abductive reasoning*. Tuscaloosa, AL: The University of Alabama Press.
- Williamson, T. (2007). *The Philosophy of Philosophy*. Malden MA and Oxford: Blackwell.
- Wittgenstein, L. (2001). *Philosophical Investigations. The German Text, with a Revised English Translation*. Malden MA and Oxford: Blackwell.
- Woods, J. (2016). Reorienting the Logic of Abduction. In L. Magnani & T. Bertolotti (Eds.), *Springer Handbook of Model-Based Science* (pp. 137-150). Dordrecht: Springer.
- Yu, S. & F. Zenker (2018). Peirce Knew Why Abduction Isn't IBE. A Scheme and Critical Questions for Abductive Argument, *Argumentation*, 32(4), 569-587.