

Is deduction a source of knowledge? Vailati on pragmatism and prediction¹

Giovanni Tuzet

Abstract: One the themes of classical Pragmatism, at least in Peirce's and Vailati's philosophy, is the cognitive role of deductive inference. Is deduction a source of knowledge? The answer seems to be in the positive when it is claimed that deductive inference draws the consequences of our hypotheses and brings them to the test of experience. I basically agree with this claim, but I also think that a careful analysis is needed on what we mean in this context by "source" and "knowledge" in particular. We must distinguish, as Vailati did, heuristic from epistemic value. Making deductive predictions does not amount to acquiring knowledge, but it certainly has heuristic value. So, deduction is not a source of knowledge if by "source" we mean a necessary or a sufficient condition of it, but it is a source of knowledge if we mean something like a heuristic device.

Keywords: Deduction, Knowledge, Inference, Peirce, Pragmatism, Prediction, Vailati

1. *Deduction, knowledge and pragmatism*

The present work deals with the cognitive importance of deduction and the pragmatist way to capture it. It is commonplace that inference in general, and deduction especially, is among the sources of knowledge. But a traditional objection against the epistemic role of deduction states that it is a logical inference whose conclusions are trivial; for they are nothing but part of the content of the premises. Inferring that q from the premises that p and that if p then q , does not add to our knowledge, reads the objection, for we already know that

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q once we know that the premises are true.²

There are various ways of resisting this critical claim about deduction. Here I will focus on the pragmatist one, defended by Charles S. Peirce and Giovanni Vailati in particular. Indeed one of the themes of classical Pragmatism, at least in Peirce's and Vailati's philosophy, is the role of deductive inference. Deduction has an important role in their pragmatist pictures of meaning and scientific method, as we shall see. But is it truly a source of knowledge? Their answer seems to be in the positive, since they claim that deductive inference draws the consequences of our hypotheses and brings them to the test of experience. I basically agree with this argument in defense of the epistemic – or, more prudently, cognitive – role of deduction. But I also think that a careful analysis is needed on what we mean here by “deduction”, “source” and “knowledge”.

To start, let us take “knowledge” as justified true belief. This is a standard definition that fits well with our ordinary practices, despite the well-known philosophical worries about it.³ (It also fits with some specialized practices as the legal one, even though in some legal contexts true belief is enough for knowledge attribution).⁴ By “source” of knowledge, instead, I will mean a cognitive process leading to knowledge. This definition will be specified in due course. And I will use “deduction” in the traditional sense of the notion, that is, to refer to an inference whose conclusions cannot be false if the premises are true.

Given these definitions, let us move to Vailati's work. Some of his papers will be taken into account and some examples will be discussed in order to assess his pragmatist response to the challenge against deduction. I will focus on Vailati and Pragmatism (§ 2), on the role of deduction in scientific method according to Peirce and Vailati (§ 3), and on deduction as providing predictions (§ 4). To be candid, I started this work endorsing the pragmatist claim on the epistemic role of deduction, and ended with some doubts about it. But my conclusion (§ 5) will be substantially in tune with the pragmatist claim, once certain specifications will be made. In particular we must distinguish, as Vailati did at some point, *heuristic* from *epistemic* value. Making deductive predictions does not amount to acquiring knowledge, but it certainly has heuristic value. So, deduction is not a source of knowledge if by “source” we mean a necessary or a sufficient condition of it, but it is a source of knowledge if we

² According to Vailati (2010: 43-44), this objection goes back to Sextus Empiricus and, in more recent times, to John Stuart Mill. Cf. Engel 1989, chaps. 12-13.

³ See the challenge by Gettier 1963 and, for some ways of responding to it, Nozick 1981, chap. 3 and Vassallo 2003 among others.

⁴ See Tuzet 2008, where I claim that in some cases liability follows from conduct based on knowledge as true belief, regardless of belief justification.

mean something like a heuristic device. More generally speaking, deduction certainly has a cognitive role if we place it in the context of scientific research and in any other context in which we draw deductive predictions out of our hypotheses and beliefs.

2. *Vailati and pragmatism*

Giovanni Vailati (1863-1909) was one of the leading figures of the philosophical debate in Italy in the early years of the 20th century. He was a mathematician who had worked with Peano and Volterra at the University of Turin and eventually developed his philosophical interests in a pragmatist direction. Not only was he in contact with William James: he corresponded with some of the most important figures of European culture at the time, including Brentano, Croce, and Pareto, and he actively participated in the most important events of those years regarding philosophy and psychology.

It is apparent that Vailati's thought and writings had a "pragmatist turn" in the years of his collaboration to *Leonardo*,⁵ the young Florentine journal founded by Papini and Prezzolini and animated also by Calderoni and Vailati himself. One cannot say that he changed his philosophical mind in such years: rather, there is a continuity in his philosophical thought. But in such years, to my impression, he focused on some pragmatist themes⁶ that he found to be congenial to his prior work, on mathematics and scientific method in particular, and he adopted a more sharp and lively style of writing (I daresay a "pre-Futurist" style well represented by Papini's own writing). *Leonardo* was an eclectic publication that ranged from literature to philosophy and political debate; for Vailati it constituted a valuable occasion of lively and constructive discussion, out of institutional strictures, bridging the gaps or at least shortening the distances between different fields of experience and thought.⁷

Vailati's main interest in pragmatism was constituted by Peirce's *pragmat-*

⁵ On this journal, that started in 1903 and ended in 1907, see the contributions collected in Maddalena and Tuzet 2007. Positively commenting on *Leonardo*, James (1906: 337) wrote that in the renewed Italian philosophical debate there were still too many partisanships and a lot of Manichaeism, but he thought they were a temporary legacy of dark times; I leave to readers the judgment whether this was wishful thinking. On Vailati and James, cf. Evans 1930: 417-419.

⁶ On Vailati and pragmatism, see e.g. Evans 1930, Pasquinelli 1963, Harris 1963-64, Zanoni 1979, Dal Pra 1984, Quaranta 1993, De Zan 2000, Maddalena 2007, Maddalena and Tuzet 2011. Cf. Minazzi 2011.

⁷ The echo of the journal was significant, in Italy and elsewhere. For instance, in a letter from 1908 Valéry noted its value but also its eclecticism (now in Valéry 1952: 82); Leonardo da Vinci was for Valéry a model of how to bridge the gaps between arts and sciences (see his *Introduction à la méthode de Léonard de Vinci* of 1894, and his following notes on the subject, now in Valéry 1957: 1153-1269).

ic maxim. This was a highly disputed topic at the time, among the original American pragmatists (Peirce and James) and their critics, as well as among their Italian followers (the writers collaborating to *Leonardo*).⁸ I cannot go into those debates here; I will just focus on Vailati's reading of Peirce's pragmatic maxim. Let me quote such maxim in its 1878 version, which is the one Vailati was acquainted with:

Consider what effects, that might conceivably have practical bearings, we conceive the object of our conception to have. Then, our conception of these effects is the whole of our conception of the object. (CP 5.402)

According to Vailati, the main advantage of adopting the maxim is that of avoiding such bad things as misunderstanding, confusion, nonsense and unnecessary multiplication of entities, focusing instead on particular consequences and applications constituting the meaning of a conception, or the meaning of a linguistic phrase. To put it in Peirce's words, adopting that maxim or rule is a way (perhaps *the way*) to "make our ideas clear" (CP 5.388ff). Vailati welcomed the maxim.

No formal rule can better help us to avoid the danger of erroneous interpretations [...] than that which advises us to determine the meaning of every phrase or abstract proposition by means of the examination of the *consequences* which are involved in it, or the *applications* which are made of it, and to regard two phrases or propositions as equivalent, or as two ways of saying the same thing (Peirce), whenever they are employed, by anyone who adopts them, as a means of arriving at the same particular conclusions. (Vailati 2010: 175)⁹

This passage belongs to a work originally published in English in 1906, *A Study of Platonic Terminology*, where Vailati stressed the importance of justifying conceptual distinctions by tracing out their particular consequences.¹⁰ If two phrases or assertions have the same consequences they amount to the same content, and their difference is merely verbal.

In his piece with Mario Calderoni on the origins and fundamental idea of

⁸ See Colella 1994, Colapietro 1994, Casini 2002 and the Editors' introduction to Maddalena and Tuzet 2007.

⁹ See also the two important papers written by Vailati together with Calderoni: *Le origini e l'idea fondamentale del pragmatismo* (1909) (S1: 116-128) and *Il pragmatismo e i vari modi di non dir niente* (1909) (S1: 129-137), now also in Vailati 2010, chaps. 18-19.

¹⁰ See also his paper *The Attack on Distinctions*, published in English in 1907 and now in Vailati 2010, chap. 14; the original Italian text can be found in S1: 29-36.

pragmatism (1909), the idea was put as follows:

The only means to determine and clarify the meaning of an assertion is to indicate which particular experiences, according to such an assertion, are going to take place, or would take place under specific given circumstances. (Vailati 2010: 234)

Of course there are differences between these formulations. Let us try to focus on the core of the idea, though. The pragmatist approach to meaning or conceptual content, in a nutshell, comes to this: the content of x is given by the testable consequences of x . The approach is promising (to avoid misunderstanding, nonsense, etc.) but suffers from some problems, including the following:

- Are the consequences the maxim deals with merely testable or also practical in some definite sense? Peirce's text of 1878 referred to practical effects; Vailati's understanding was in terms of testable consequences. The maxim is susceptible to both a practical and an experimental reading;¹¹
- What about past entities? It is hard to say what the practical or testable consequences are of our beliefs or assertions about things that do not exist anymore;¹²
- How to distinguish between conscious beings and automata? The observable consequences of our stimulation of them might be the same;
- How to determine the meaning of normative claims? Such claims (e.g. "You ought to do A ") do not have testable consequences, unless one reduces their normative meaning to factual happenings.¹³

However, for Vailati adopting the pragmatic maxim was a way to support and extend his previous reflections on mathematical logic. Insofar as mathematicians draw the deductive consequences of their starting points, they provide a model of how to determine the content of our conceptions and bring them to the test of experience. Peirce said that deduction is "the only necessary reasoning" and is "the reasoning of mathematics" (CP 5.145; cf. CP 3.558 and 4.229). According to Zanoni, indeed, "Vailati saw in Peircean pragmatism a natural extension into philosophy of his own views on the nature and function

¹¹ This was the object of a polemic discussion between Calderoni and Prezzolini. See the exchange in Frigessi 1960: 165-176, 213-231. Cf. Villa 1963.

¹² This and the following issue are considered in Vailati 2010: 243-244. See also Vailati 1971: 470.

¹³ I have discussed this problem and the issue of responsibility in Tuzet 2007 and 2016.

of mathematical logic".¹⁴ I have no competence to go into the details of mathematical topics, but I wish to point out that the pragmatic maxim or rule is a non-formal version of Peirce's mathematical and experimental logic.

Because it explored the consequences of pure hypotheses by experimenting upon representative diagrams, mathematics was the inspirational source of the pragmatic maxim, the jewel of the methodological part of semeiotic, and the distinctive feature of Peirce's thought. As he often stated, the pragmatic maxim is little more than a summarizing statement of the procedure of experimental design in a laboratory – deduce the observable consequences of the hypothesis. (Ketner and Putnam 1992: 2)

This was made clear in Vailati's 1906 paper *Il pragmatismo e la logica matematica*.¹⁵ Now it is remarkable that deduction does the work here, for, inferentially speaking, drawing the consequences of our hypotheses, beliefs, assertions or theories, is nothing but operating a deduction from such items to their consequences, testable or at least conceivable.¹⁶

In this pragmatist perspective deduction plays two major roles, conceptual and epistemic respectively: (1) it is a method for finding out whether a given belief, assertion, or theory is *meaningful*, since a belief, assertion, or theory is not meaningful if no definite observable consequence can be predicted from it;¹⁷ (2) it is a method for finding out whether a meaningful belief, assertion, or theory is *true*, since a belief, assertion, or theory is not true if subsequent observation falsifies the predictable consequences of it, and it is likely true if subsequent observation verifies its predictable consequences (more on this below).

Vailati improved the maxim in a very important way: he pointed out that it can significantly play its conceptual role only within a whole system of items.¹⁸ He reviewed Duhem's theoretical work on physics and realized that the maxim needs some background knowledge and a system of interconnected items.¹⁹ If you apply the maxim to belief, it can single out which beliefs are meaningful and what their meaning is only if you have a system

¹⁴ Zanoni 1979: 607. Cf. Santucci 1963.

¹⁵ Now in Vailati 2010, chap. 12.

¹⁶ "Pragmatism, considered as a methodological process for the assessment of the meaning of assertions, is closely connected with the role of deduction" (Zanoni 1979: 609). On deduction and diagrams, cf. Netz 1999.

¹⁷ Cf. Evans 1930: 420-421.

¹⁸ See S1: 277, 385-386; S3: 226-228. See also Vailati 1911: 594-595, 755, 759 and Vailati 1971: 140. Cf. Calderoni 1924, vol. I: 260-261; vol. II: 150, 158-159.

¹⁹ See Frigessi 1960: 247-249. Vailati pointed out that both *meaning* and *confirmation* are a systemic affair. Today scholars distinguish in this respect two branches of holism, semantic and epistemic.

of beliefs. It does not work with individual beliefs considered *per se*. If you apply it to assertion, it can single out which assertions are meaningful and what their meaning is only if you have a whole language system permitting a potentially infinite number of assertions and various speech acts including assertions. Of course some relevance constraints will be needed to select the relevant consequences;²⁰ but the basic idea is that you can determine the consequences of a given belief or assertion only if it is part of a system. The same is true if you apply it to more abstract things as propositions. “One of the important features of the pragmatist method is that it shows how the meaning of propositions can be sought in their consequences; consequences, however, not of individual propositions, but rather of a system of propositions”.²¹ To put it in philosophical jargon, Vailati’s improvement of the maxim was a *holistic* one. Meaning is not an individual affair. It is a property of systems and their parts. (Notice that this contradicts Quine’s interpretation of pragmatism,²² according to which pragmatism – including its Peircean version – did not make the crucial step of moving our semantic focus from individual sentences to systems of sentences.)

This being said about the conceptual role of deduction according to the pragmatic maxim, let us focus on the *epistemic* role of deduction.

3. *Deduction in scientific method*

3.1. *Peirce*

According to Peirce’s conception of scientific method, deduction draws the consequences of our hypotheses, but it is not an ampliative inference. Abduction is so, because it formulates new hypotheses, or introduces “new ideas” in our thinking (CP 2.777, 5.171). Abduction is ampliative, deduction is not. Still, in some papers Peirce makes a distinction between Corollarial and Theorematic Deduction:

A Corollarial Deduction is one which represents the conditions of the conclusion in a diagram and finds from the observation of this diagram, as it is, the truth of the conclusion. A Theorematic Deduction is one which, having represented the conditions of the conclusion in a diagram, performs an ingenious experiment upon the diagram,

²⁰ See Vailati 2010: 245.

²¹ Zanoni 1979: 609. Cf. De Waal 2005: 79-80.

²² See Quine 1981.

and by the observation of the diagram, so modified, ascertains the truth of the conclusion. (CP 2.267, c. 1903)²³

Corollarial deduction, exemplified by a simple syllogism such as Barbara, is not an ampliative inference. It is analytic in the Kantian sense according to which its conclusions are already part of the premises. Now the question is: Is theorematic deduction ampliative? Consider again what I will call the *Content Objection*: one might say that a theorematic deduction is still an analytic inference, and not synthetic one, because the conclusions do not add to the content of the premises. I guess that Peirce, elaborating on theorematic deduction, was wondering about a way to inferentially accommodate what Kant termed “synthetic a priori”: the conclusions of a theorematic deduction can be drawn a priori, but they are not known before the inference is performed (together with the experiment upon the diagram); so they are both synthetic and a priori.

I am not sure that Peirce’s argument on theorematic deduction was sound. I suspect that even a theorematic deduction, *once its premises are elaborated upon the diagram*, draws something which is already part of the premises. If this is correct, the conclusions do not add to the content of the premises. Therefore, if that is correct, deduction is not an ampliative or synthetic inference, neither in the corollarial nor in the theorematic form.

However, there are some possible ways to defend the novelty of (some) deductive conclusions, or their cognitive value. One idea is to distinguish (a) being *informative* from a psychological point of view from (b) being *ampliative* from a logical point of view. Some deductive conclusions satisfy the former requirement at least, especially when they deal with complex matters, or unobserved phenomena, or sophisticated scientific issues. Another idea is to say that the virtue of deduction consists in making the content of the premises explicit. This might be defended by elaborating on some inferentialist picture of content.²⁴ A further idea is to focus on the role of deduction in scientific method, as Peirce did in fact when he pointed out that deduction puts hypotheses to the test of experience by drawing their testable consequences (CP 5.403-410, of 1878; CP 5.579, 5.590, of 1898; CP 7.163, 7.182, 7.203, of 1901; CP 5.161, 5.196, of 1903). Vailati followed the same hint.

²³ Cf. CP 2.778, 4.233, 7.204. On theorematic and corollarial deduction in Peirce, see also Tuzet 2006a, §§ 23-24 and Tiercelin 1995: 62-64.

²⁴ See in particular Brandom 1994: 189-190 and 2008: 120-121.

3.2. *Vailati*

Deduction plays a major role in the scientific domain, for Vailati, as a “heuristic device” or “instrument of research” (*strumento di ricerca*). According to the traditional critique, namely the content objection, deductive conclusions are perfectly trivial since they are nothing but part of the content of the premises. Vailati’s reaction against this (trivial?) claim is the subject of his well-known “prolusione” of 1898: *Il metodo deduttivo come strumento di ricerca*.²⁵ The motivation for this work by Vailati came not only from his mathematical education but also from his critical stance towards the positivist endorsement of induction as the most important inference in scientific method and research; Vailati vindicated the role of deduction.²⁶

Deduction is central to scientific method, says Vailati. For deduction draws the consequences of our hypotheses; such consequences have to be tested, in order to assess the hypotheses they depend upon. He admits that a simple syllogism like Barbara does not add to our knowledge. But things are different if you consider more complex forms of deduction.

There are deductions and syllogisms where something more and different is done than merely applying a general rule to a special case, a special case where it is possible to directly recognize the presence of the characters that make the general rule applicable. There are syllogisms where both premises are general propositions, and where the conclusion is a new general proposition that would not have been able to be proved by induction, without resorting to *observation or experiences that would be completely different from those by which the corresponding premises have been, or could have been, proved*. (Vailati 2010: 45)

In general, anytime we come to know with certainty that a given phenomenon *A* is constantly connected with the phenomenon *B*, not through a generalization directly based on the examination of the facts where we can see the connection between the two mentioned phenomena, but instead through our previous knowledge of a connection between *A* and a third phenomenon *C*, and moreover of a connection between *C* and *B*, the syllogism that represents this mental operation really provides a *growth of our knowledge* [avanzamento delle nostre cognizioni]. (Vailati 2010: 46; my emphasis)

Vailati, profitably cultivating the history of epistemology, draws a line between deduction in Greek science and philosophy, where it was just a “demonstration device” (*strumento di dimostrazione*), and deduction in modern sci-

²⁵ S2: 18-48 and Vailati 2010, chap. 2.

²⁶ Cf. Restaino 1963: 368-369.

ence, where it is also a “heuristic device”. He provides to this effect various examples taken from the discoveries of modern science and Galileo in particular.²⁷ In the Greek use deduction is employed for the demonstration of disputed or uncertain conclusions. In the modern use it is employed for the testing of uncertain or doubtful premises.

There is more. The holism of meaning that Vailati highlighted in the operation of the pragmatic maxim has a parallel in epistemology, the holism of confirmation. There is a *mutual control* and a *mutual support* between the premises and the conclusions of a deductive inference. The premises logically support the conclusions, and the conclusions empirically support the premises when the predicted consequences are observed.²⁸

The Italian philosopher does not discuss the Peircean idea of *abduction* concerning the formulation of hypotheses; probably, he was not acquainted with it. In any case, one might ask whether deductive inferences provide in Vailati a logic of both discovery and justification.²⁹ This seems to be the case, if we stick to the traditional claim that deductive conclusions are logically justified and we follow Vailati in thinking that (some) deductive conclusions add to our knowledge.

At some points Vailati is quite clear in distinguishing heuristic from epistemic value;³⁰ at other points he insists that one advantage of deduction consist in its being a heuristic device and not only a means of proof (“*mezzo per mettere alla prova*”).³¹ When he makes the distinction between the different uses of deduction he focuses, on the one hand, on deduction as a means of proof and demonstration and, on the other, as an instrument of research and ideal construction. This last remark deserves some comments.

Vailati claims among other things that deduction has a crucial role in “thought experiments”, making abstraction from empirical testing. So, deduction is important not only in science but also in philosophy and abstract speculation. In his view even Platonic theory, divested of its ethical and aesthetical implications,

²⁷ See especially Vailati 2010: 28, 32-35.

²⁸ Vailati 2010: 52. De Waal (2005: 166-167) compares Vailati’s contention with Haack’s analogy of the crossword puzzle – see for instance Haack 1993, chap. 4 and Haack 2014: 13-16 – and claims that mathematical proof is different. “In contrast to mathematical proof, which is one-directional, a crossword puzzle allows for a pervasive mutual support among beliefs, and shows how this is possible without lapsing into a vicious circularity” (De Waal 2005: 167).

²⁹ A further interesting issue for scholarly reflection might be the comparison of Vailati’s account of deduction with Popper’s method of conjecture and refutation and Hempel’s hypothetico-deductive method.

³⁰ See in particular S2: 172 and S3: 240.

³¹ Vailati 1971: 275. Cf. S3: 202; Vailati 1971: 275-278, 305, 356; Vailati 2010: 11, 30, 39, 52-53.

manifests itself as an assertion of the heuristic efficacy of that process of inquiry, which, taking as a starting point, idealistic and simplifying concepts and hypotheses, not having any exact counterpart in what is called the *reality of things*, arrives, precisely by means of deductions from these, and by means of what have been recently called (Mach) “experiments in thought” (*Gedankenexperimente*) at analysing, comprehending, dominating this reality and discovering in it and under it, independently of recourse to direct experiment, regularity, laws, standards, which direct and passive observation would never have been able to reveal. (Vailati 2010: 181)

Vailati says that, so understood, the theory of ideas “appears more intimately connected than would be generally admitted with the other great innovation in method attributed to Plato, *viz.*: the employment of deductive reasoning in the choice and the rejection of the various hypothetical alternatives which present themselves as possible with regard to a given subject” (Vailati 2010: 181). Notice that the observed consequences of a hypothesis are just a part of the observable ones and these are just a part of the conceivable ones.

Now, if we go back to our starting question, is all this enough for the claim that deduction is a source of knowledge? What about the content objection? The more complex a deduction is, the less force the objection has? Are abstract deductions with general premises sources of knowledge? Are thought experiments carried out by means of deduction sources of knowledge?

An additional way explored by Vailati to resist the standard objection against the epistemic role of deduction consists in challenging the metaphor according to which deductive conclusions are nothing but part of their premises. This is done in a short and insightful paper published in English in 1908 under the title *On Material Representations of Deductive Processes*.³²

Vailati claims that in our characterization of deduction three groups of metaphors are mainly employed, namely the metaphors of support, of descent, and of content. More in detail, the *first* is “the conception of ‘upholding’ or ‘supporting’, as, for instance, when it is said that given conclusions are ‘based’ upon, or ‘founded’ upon, given premises”; the *second* are the “metaphors of ‘ascending’ or ‘descending’, as when we speak of consequences which ‘descend’ from or may be ‘traced up’ to certain principles”; and the *third* are the metaphors “referring to the relation of ‘containing’ or ‘including’” (Vailati 2010: 198).

A characteristic of the first two groups of metaphors “consists in their lending themselves to the embodiment of one of the most radical objections that

³² The paper, originally published in *Leonardo* in 1905 under the Italian title “I tropi della logica”, is now in S1: 21-28 and in Vailati 2010, chap. 15; see Cecchinè 1963. On deduction and chemical metaphors in Schopenhauer, cf. Picardi 1994: 194-203.

can be raised against deduction as a means of proof and ascertainment of truth”, that is, the objection that “all processes in which an attempt is made to prove some assertion by deducing it from another must be based, in the ultimate analysis, upon assertions which, in their turn, cannot be deduced from any other” (Vailati 2010: 199). According to this, “a man who only deduces could not be regarded as a *producer*, but simply as a *distributor* of ‘certainties’”. (199). But Vailati points out that, in many cases, the truth or certainty of the conclusions, deducible from given premises, is “apt to increase and consolidate the certainty of the premises themselves” (199-200). This goes back to the claim of mutual support considered earlier.

On the third group of metaphors, he observes that the content objection can be pushed up to the point of claiming that deductive conclusions say even less than their premises.

To say that the conclusions of a piece of deductive reasoning are to be found, even “implicitly” “contained” in the premises, differs, indeed, very little from saying that they not only assert *nothing more*, but even assert *something less*, than what is already asserted in the premises themselves. (201)

Against this critical claim Vailati notes that, in the opposite direction, premises may be regarded “not as ‘including’ or ‘implying’, the conclusion itself, but, on the contrary, as the more ‘simple’ elements *of* which it is ‘composed’ or *into* which it may be ‘resolved’” (202). There is however a drawback of these chemical metaphors, “consisting in their tendency to give rise to a false (too absolute) view of the contrast between simple and complex truths, and to present as the supreme ideal of scientific research the determination of propositions absolutely primordial, non-decomposable, atomic, capable of generating all others by their various aggregations” (202).

All of that is interesting and insightful; still, Vailati’s paper on the metaphors of deduction has no definite conclusion. Vailati provides a very smart examination of the merits and demerits of those metaphors; but no definite conclusion is drawn in favor of one of them over the others. So, the content objection is still unanswered.

4. *Deduction, prediction and content*

Both in his own writings and in the pieces with Calderoni,³³ Vailati puts a special emphasis on *prediction* as a way to determine the content of our beliefs.

³³ See especially Vailati 2010, chaps. 18-19 and S3: 157-252.

To determine the content of the belief that there is a chair in front of me, I need to predict in particular the sensory experiences I will have if the belief is true. The richer the predicted consequences, the richer the content of belief. This is in tune with Peirce's pragmatic maxim (especially if read experimentally). And it is relevant to our topic insofar as predictions are made by drawing the deductive consequences of our hypotheses or beliefs. So the idea is that some such hypotheses or beliefs can turn into knowledge when we positively test their consequences.

Testing the consequences of hypotheses or beliefs is what all inquirers do, from everyday contexts to specialized scientific ones.³⁴ But the view that we so determine not only the content of our hypotheses or beliefs but also their epistemic value is a quite problematic one. For one thing, we incur in the fallacy of affirming the consequent if we infer the truth of a hypothesis from the truth of one or more of its consequences.³⁵ For another, the predictive account of content suffers from a couple of specific problems at least, which I will call the infinite progress problem and the predictive insufficiency one.

Let me state the *Infinite Progress* problem. If we define beliefs in terms of predictions and if subsequent observations amount to observational beliefs, these are nothing but predictions in their turn, namely predictions of further future experiences. This leads to the problem of infinite progress: in order to determine the content of a given belief, we must infinitely move on from experience to experience, far away in the future, never stopping to anything definite and concrete.

Additionally, let us consider the *Predictive Insufficiency* problem. Remember that a predicted consequence may turn out to be false. Abstracting now from the infinite progress problem, it is observation that tells us if a predicted consequence is true or false – and therefore if the belief or theory it is a consequence of is confirmed or not. So, predictions *per se* are not knowledge. Only a predicted consequence that is found to be *true* amounts to knowledge. And, if knowledge is justified true belief, the prediction must be *justified*, that is, based on reliable data and assumptions. A prediction made by chance does not amount to knowledge even if it happens to be true.³⁶ In turn, the relevant hypotheses or beliefs amount to knowledge only if true and sufficiently confirmed by subsequent observations. In sum, prediction is not sufficient.

³⁴ Cf. among others Haack 2019: 2054.

³⁵ The inference would be correct only if supported by a biconditional ("if and only if") connecting the hypothesis and the tested consequences. However, with non-deductive standards such as abductive ones it can be perfectly reasonable to infer that *p* from the observation that *q* and the premise that if *p* then *q*. See especially CP 5.189.

³⁶ I make abstraction from further Gettier-style complications.

Let me take an example from the practical domain, namely Oliver Wendell Holmes' "prediction theory" of legal rights and duties. Holmes – a former member of the Cambridge "Metaphysical Club" which was the cradle of philosophical Pragmatism, then a judge and a member of the US Supreme Court³⁷ – claimed that legal rights and duties amount to predictions of what courts will do given certain conditions.

A legal duty so called is nothing but a prediction that if a man does or omits certain things he will be made to suffer in this or that way by judgment of the court; – and so of a legal right. (Holmes 1897: 458)

Why predictions of such sort? To distinguish law from morality, and to distinguish law in concrete contexts (law in force) from law in the abstract. Holmes introduced to this effect the "bad man" character, someone who just cares for the "material consequences" of his conduct.

If you want to know the law and nothing else, you must look at it as a bad man, who cares only for the material consequences which such knowledge enables him to predict, not as a good one, who finds his reasons for conduct, whether inside the law or outside of it, in the vaguer sanctions of conscience. (Holmes 1897: 459)

Even if morality has always had an influence on the law, "nothing but confusion of thought can result from assuming that the rights of man in a moral sense are equally rights in the sense of the Constitution and the law" (Holmes 1897: 460). According to this, one may say that the claim "You legally ought to do *A*" amounts to a prediction that, if you will not do *A*, a court will sanction you. Suppose then that you do not do *A* and a court doesn't sanction you. The conclusion of the inference about the duty to do *A* turns out to be false, and this would count as a falsification of the claim about your duty. Instead, if the court sanctions you, this would count as a confirmation of the claim.³⁸

To be fair, Holmes' account of law in terms of predictions was seriously flawed if understood as a conceptual account of what it means to have a legal right or duty. Normative concepts and claims cannot be logically reduced to factual happenings like individual decisions, even when it comes to institutional decision-makers like judges. (This goes back to one of the problems of the pragmatic maxim, namely the last of the above list). Holmes' claim was

³⁷ See among others Fisch 1942, Miller 1975 and Haack 2005.

³⁸ Of course, things are far less neat if the picture includes probabilities (like the probability of being sanctioned). A realistic picture needs them, but we can abstract from them here.

not flawed, instead, if understood as an empirical account of the connection between legal rights or duties and judicial decisions.³⁹ As an empirical claim, a predictive account may turn out to be true and justified. If so, it amounts to knowledge about the judicial application of law.

In light of the preceding considerations, prediction theories can be taken as contributions to the knowledge of the law and its application, rather than theories of law as such. In any case we should not take prediction for knowledge. A prediction has a propositional content capable of being true or false, and if it turns out to be false it is not knowledge of course. Still, predictions are “heuristic devices”, and perhaps they are indispensable if we want to get full knowledge of the law in force. Predictions need to be tested in order to see if the hypotheses they are based upon are true or false. The point can be generalized to any context in which hypotheses are put to the test of experience by drawing their testable consequences.

In particular, deduction is a necessary step in the process that provides conclusive evidence against a hypothesis on a singular event; once the hypothesis is made, its consequences are deductively drawn and empirically tested: if the test of experience tells us that they are false, the hypothesis is falsified and, in case the hypothesis is a criminal one, the person accused cannot be convicted.⁴⁰ But, more often, such a process cannot provide conclusive evidence in favor of the hypothesis. At least, we can say that it may provide supporting evidence in favor of it.

5. *A Skeptical Conclusion?*

It is time to take stock. Take a syllogism in the Barbara form. If you know that the premises are true, the conclusion is trivial. If you don't know and deduction is a heuristic device, *per se* it does not provide knowledge.

Things can be different with more complex forms of deduction, as Vailati pointed out. Still, deduction is neither a necessary nor a sufficient condition of knowledge. It is not a sufficient condition of knowledge because predicted consequences drawn by deduction from a given hypothesis may turn out to be false. Additionally, if they turn out to be true they do not imply the truth of the hypothesis; they just confirm it to some degree. Nor is deduction a necessary

³⁹ The classical reference against prediction theories of law is Hart 1961. I developed myself the critique, with respect to Calderoni's claims on law and morality, in Tuzet 2007; see also Tuzet 2013. For a defense of Holmes' claim as empirical, see White 2004. Cf. Tiercelin 1997 on Peirce's conception of norms.

⁴⁰ On deduction as falsifier of factual claims, see Tuzet 2006b. On deduction and normative claims, see instead Tuzet 2005.

condition of knowledge, because we may come to have a justified true belief in various different ways, not just by deduction.

Therefore, deduction is not a *source of knowledge* in the strong sense according to which *per se* it results in a justified true belief. However, Vailati was right in claiming that deductive inference is a “heuristic device”, if by “heuristic device” we mean a tool or a process which *may* lead to knowledge, something possibly knowledge-conducive, not necessarily so. Deduction is a source of knowledge in this weak sense. It is certainly a cognitive tool.

One key point in the claims about inference as a source of knowledge consists in the meaning of “source”. As I just pointed out, if “source” is read as a logical condition, deduction is not a source of knowledge. This is also true of other uses of “source”, by the way, as in “The death of one’s pet is a source of sorrow”. Sorrow is what usually occurs on that event, but sorrow can result from different events, and in some contexts the death of one’s pet might not result in sorrow (if the person dies as well, or believes the pet is still living, and so on). That is also true of other “sources” of knowledge, like testimony. Testimony is neither a necessary nor a sufficient condition of knowledge, for knowledge can result from other “sources” and because some testimonies are false, misleading, and so on. In the weak sense of “source” also abduction and induction are sources of knowledge, being possibly knowledge-conducive. One virtue of Peirce’s conception of scientific method was that the value of distinct inferences lies in their combined and ordered operation: abductive formulation of hypotheses, deductive elaboration, inductive testing.

Another strategy to answer our question might consist in relaxing the notion of “knowledge”. If “knowing” is read as having a justified belief, or having reliable information, deduction necessarily provides something of this sort. Then one might claim that deduction is indeed a source of knowledge, even subscribing to some strong sense of “source” (combined with some weak reading of “knowledge”). I cannot expand here on this strategy, though.

Hence, my conclusion is skeptical if we put too much into the notion of an epistemic “source”. But deduction is certainly a source of knowledge if, following Vailati, we mean to say that it is a heuristic device to put hypotheses and beliefs to the test of experience.

Giovanni Tuzet
Bocconi University, Milan
giovanni.tuzet@unibocconi.it

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CP

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S

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