Synthese (2021) 199:3207–3217
https://doi.org/10.1007/s11229-020-02932-5

Logical abductivism and non-deductive inference

Graham Priest[1,2]

Received: 6 June 2020 / Accepted: 20 October 2020 / Published online: 25 November 2020

Abstract
Logic, in one of the many sense of that term, is a theory about what follows from what and why. Arguably, the correct theory has to be determined by abduction. Over recent years, so called logical anti-exceptionalists have investigated this matter. Current discussions have been restricted to deductive logic. However, there are also, of course, various forms of non-deductive reasoning. Indeed, abduction itself is one of these. What is to be said about the way of choosing the best theory of non-deductive inferences? It would seem clear that an anti-exceptionalist should hold that essentially the same method of choice should apply to non-deductive logic. A number of issues need to be faced in the process, not the least of which is the circularity involved in an abductive justification for a theory of abduction. This paper discusses matters.

Keywords Logical abductivism · Abduction · Induction · Problem of indiction · Logical revision

1 Introduction

Logic, in one of the many sense of that term, is a theory about what follows from what and why. Arguably, the correct theory has to be determined by abduction; and over recent years, so called logical anti-exceptionalists have investigated this matter. Current discussions have been restricted to deductive logic. However, there are also, of course, various forms of non-deductive reasoning. Indeed, abduction itself is one of these. What is to be said about the way of choosing the best theory of non-deductive inferences? It would seem clear that an anti-exceptionalist should hold that essentially the same method of choice should apply to non-deductive logic.

In this paper I discuss the matter, clarifying and examining. A central issue that will appear is that of the circularity involved in using abduction to determine a theory of

✉ Graham Priest
priest.graham@gmail.com

1 Departments of Philosophy, The CUNY Graduate Center, New York, USA

2 The University of Melbourne, Melbourne, Australia

abduction. As we will see, the issue fragments into a number of different scenarios. Some of them are relatively straightforward, and some of them are not. I shall make comments on the latter ones, but I warn the reader that definitive solutions are not to be found in this paper. The best I can do is put the issues on the table as a prolegomenon to further discussion.

2 Logical abductivism

First, let us get some background straight.

Logic—for the moment, deductive logic—in one of the many senses of that term, is, as I noted, an account, or theory, about what follows from what and why.[1] As anyone who knows a little of the history of Western logic can see, there have been numerous such, very different, theories: those of Aristotle, the Stoics, Abelard, Buridan, Frege, Heyting, to name but a few of many.[2] Why was one theory deemed (hopefully, rationally!) preferable to another? More generally, given a bunch of such theories, how should one determine which one is rationally preferable?

In the history of Western philosophy, the standard view, as espoused most notably by Kant, is to the effect that there is something special about logic, so that the mode of determination of the best logical theory is quite different from the mode of determination of the best theory concerning a more mundane matter. However, of late, many philosophers—myself included[3]—have rejected this view. Instead, we hold that that there is essentially a uniform procedure of rational theory choice, applying to all theories, whether they be about logic or something else. The exact details of the way in which the method is applied may vary somewhat from domain to domain; but *au fond*, it is the same for all domains. The method is abduction, that is, inference to the best explanation. This view about logic has come to be called *logical anti-exceptionalism*.[4] I find this a rather ugly term, and potentially misleading in a number of ways. So I shall simply call it *logical abductivism*.

3 Non-deductive inference

So much for deductive logic. As well as deductive logic, there is, of course, non-deductive logic—traditionally called ‘inductive logic’. Non-deductively valid inferences are ones where the premises ground the conclusion is some sense; but it *could* be the case that the premises are true and the conclusion is not—and so, in particular, where the conclusion may fail if further premises are added (non-monotonicity).

Of course, there are connections between systems of deductive logic and systems of non-deductive logic; but one might see the two to deliver a case of logical pluralism.[5]

[1] On the many senses of the word ‘logic’, see Priest (2014).

[2] Again, see Priest (2014).

[3] See Priest (2016, 2019).

[4] For an introduction, see the articles in Hjortland (2019a), and especially (Hjortland 2019b).

[5] Though see Priest (2006b), Sect. 12.12.

Be that as it may, there are clearly a number of different kinds of non-deductive inference, such as the following (I make no claim that these categories are exhaustive):

- "*Straight Indiction*": all crows observed so far are black. So all crows are black.
- *Typical cases*: Tweety is a bird. Most birds can fly. So Tweety can fly.

and of course:

- *Abduction*: the car has stopped and the fuel gauge shows empty. So the car has run out of fuel.

Now as is clear to a moment's reflection, we may ask exactly the same question of non-deductive inference as was asked of deductive inference. A theory of non-deductive inference tells us what follows non-deductively from what, and why. How, then, do we determine the rationally most acceptable theory of this matter?

Clearly, one might hold that it is to be determined in its own distinctive fashion. However, that answer is unlikely to be endorsed by a logical abductivist about deductive logic, for the obvious reason. If there is indeed a uniform method of rational theory choice, and if this is abduction in the case of deductive logic, it must be abduction in the case of non-deductive logic as well. Indeed, no one, as far as I know, has ever suggested a Kantian approach to non-deductive logic.

So, it seems, the correct account of what follows from what non-deductively must be determined by abduction also. Is there a single account of non-deductive inference which covers all kinds of such inferences: in other words, does non-deductive inference itself deliver a case of logical pluralism?[6] *Prima facie*, the variety of different kinds of non-deductive inference gives such logical pluralism a certain plausibility. However, since abduction is the focus of concern for logical abductivists, we may concentrate on that, and leave the question of whether and how it might fit into a more general schema for another occasion.[7]

4 Abduction: a closer look

So let us take a closer look at abduction.[8] A non-deductive inference, abduction included, is of the form $P_1, \ldots, P_n \vdash C$. In deductive logic it is not uncommon to consider more general forms of inference, where there may be an infinite number of premises and/or multiple conclusions. However, this generalisation has nothing much to offer the present matter, so we may stick with the simple formulation.

What, however, are the premises and conclusion of an abductive inference? The premises are easy. They are whatever it is of which the conclusion is supposed to provide the best explanation. The conclusion, C, is a little tricker. Sometimes the

[6] Logical abductivism is not, *nota bene*, committed to either logical monism or logical pluralism logic itself. See Priest (202+).

[7] Priest (2006b), Sect. 12.12, suggests a general format for all non-deductive inferences.

[8] For a first look at abduction, see Douven (2017). There are certainly a number of ticklish issues concerning abduction—and in particular, the exact way in which the making of (successful or unsuccessful) predictions figures into an account of what the best explanation is. But what follows in not committed to any particular position on this matter, so we need not go into it here. I discuss it briefly in Priest (202+), fn 6.

natural candidate may be a single sentence, as we saw in the last section. But often, as in the case of logic, it will be a whole theory, T. What we would like to say is that the conclusion of the inference is T; but that won't quite do, since in general theories are not sentences (though a sentence can be thought of as a simple case of a theory). With a certain amount of artifice we may sometimes be able to formulate a theory as a single sentence. Thus, if a theory is axiomatised, and has a finite axiomatisation, we may take as C the conjunction of all of its axioms. But many theories are not finitely axiomatisable; and despite the standard logicians' definition of 'theory', most real-life theories are not deductively closed sets of sentences, but something more loose and flexible. Consider only: the theory of evolution, the theory of the Big Bang. Even the theory of classical logic is like this, once one takes to heart all that is packed into the term over and above a simple axiomatization of the consequence relation—translations into natural language, auxiliary assumptions to handle aberrant cases of concerning the conditional, and so on. Given these things, one may take C to be of the form 'T is true' (in whatever sense of 'true' is deemed relevant). In what follows, and to avoid prolixity, I shall write T in sentence places with that understanding. In particular, the conclusion of an abductive inference is a theory, T.

At least in the simplest case. Matters may be a bit more complex than this. In any realistic situation, there will be more than one possible explanation. Thus, in the example abduction of the last section, a simultaneous failure of the fuel gauge and the fuel injector would also explain what is observed. Clearly, that is a less plausible explanation, though. But sometimes there will be explanations that are equally plausible. Suppose that someone, a, fronts up at a doctor's surgery with certain symptoms. The most likely explanation of the symptoms is some kind of viral infection, but without further information it could be Virus_1 or Virus_2. So two theories provide equally good explanations: T_1, that a has Virus_1, and T_2, that a has Virus_2. Then the conclusion has to be a disjunction $T_1 \vee T_2$. (Really: T_1 is true or T_2 is true.) And what then? If the doctor wishes to determine which of the two theories is better, they will seek more data (for example from lab tests) to deliver a more determinate abduction.

5 Theories of abduction

Which brings us to theories of abduction themselves. In an abductive inference, we have a set of possible explanations—theories—on the table, say $\mathfrak{T} = \{T_1, \ldots, T_n\}$. Which one of these is the correct conclusion?

It is clear that when we evaluate a theory we take into account many relevant considerations. The first, and most important, is adequacy to the data: that which the theory is meant to explain. But other standard criteria include simplicity, paucity of *ad hoc* auxiliary assumptions, power, unifying ability, etc. How are these considerations to be aggregated to form an over-all conclusion?[9]

[9] I note, as did a referee of a previous draft of this essay, that there may be some dispute about what the relevant data are. As an example from the history of science: should a theory of motion on Earth explain the motions of heavenly bodies? For what it is worth, my view is this. The moot data is at least potential data, and the more of it a theory explains is better. So its relevance is captured under the criterion of theoretical

There are various possible answers to the question. Here, I will do no more than outline two of them. To discuss them in detail would take us off the track of this paper. I put them on the table here so that the reader can see that there *are* different theories of abduction. Those familiar with the contemporary literature on philosophical logic will be well aware that there are different theories of deductive validity. But non-deductive validity may be a much more unfamiliar to many, and so people may not be aware that there are different possible theories.

Here is the first. If C is our set of criteria, one idea is to assign each criterion, $c \in C$, a number, w_c, representing its relative importance; and for each theory, $T \in \mathfrak{T}$, to assign it a numerical value $\mu_c(T)$, representing how well it behaves according to criterion c. We may then aggregate these as a weighted average: $\rho(T) = \sum_{c \in C} w_c.\mu_c(T)$. The valid conclusion of the abduction will then be that T_i for which $\rho(T_i)$ is the maximum—or if there is more than one of these, their disjunction.[10]

Here is the second. For each $T \in \mathfrak{T}$ and $c \in C$, there is a statement, $E_c(T)$, of the form 'T performs in such and such a way on criterion c'. Perhaps *such and such* will be some kind of quantitative measure (as before); perhaps it will be purely qualitative. We may then have a suitable conditional probability measure, $Pr(A/B)$, and for each T we will have a conditional probability, $p(T) = Pr(T/\bigwedge_{c \in C} E_c(T))$. The valid conclusion will then be that theory, T_i, for which the value of $p(T_i)$ is highest. Or as before, if there is more than one theory of maximum value, the disjunction of these.

Of course, if probabilities are to be used in an account of the choice of a logical theory, we will have to be more careful about probability than usual. According to standard probability theory, if a sentence is logically true, its probability is 1; and if it is logically false, its probability is 0. So for any logical theory, T, and any statement evidence, E, $Pr(T/E)$ is 1 or 0—1 for the correct theory; 0 for the others. This at least gives the right answer! But the problem is obvious: the probability is insensitive to the evidence! We need a probability measure that is evidence-sensitive. That is, we need a measure of probability that assigns non-extreme measures to logical truths. That way, $Pr(T/E) = Pr(T \wedge E)/Pr(E)$ may change for different Es. There are certainly ways to obtain such a probability function, but here is not the place to go into matters.[11]

Footnote 9 continued
power. And if a theory claims that the data is not relevant, there had better be a decent explanation of why not, or writing it off will be *ad hoc*.

[10] For further discussion, see Priest (2016, 2019).

[11] Here is a sketch of one way. (The germ of this idea is to be found in Priest (2006a), Sect. 7.6.) Take a finite Routley/Meyer model for a relevant logic. (I am not assuming that this is the correct logic, merely that its models can deliver a probability theory with the necessary properties.) In such a model we may distinguish between the possible (normal) and the impossible (non-normal) worlds. And we can arrange things such that, for any sentence A, there is world (maybe impossible) where A holds, and a world (maybe impossible) where A fails. (See Priest 2008, esp. 10.11, ex. 11). Now let μ be a measure on subsets of worlds. We may then define $Pr(A)$ as $\mu\{w \in W : A \text{ holds at } w\}$. Clearly, for any A, $Pr(A)$ will be neither 1 not 0. Of course, not all of the usual Kolmogorov axioms of probability theory—notably, those for negation—are going to hold. But it remains the case that if $A \rightarrow B$ is a logical truth, $Pr(A) \leq Pr(B)$.

What we have seen, then, is that there are at least two ways in which one may formulate a theory of abduction; and of course there may well be others.[12]

How do we choose the best? For reasons I have discussed, the choice should be an abductive one. We are using abduction to justify something about abduction. Clearly there is a circularity in this. This will start to ring alarm bells.

6 "The justification of induction"

In particular, it will ring bells related to the so called problem of induction.[13] This is usually raised with respect to straight induction, though it could be raised equally with regard to all kinds of non-deductive inference. Since the premises of the inference can be true without the conclusion being so, how can they justify it?

There are many putative solutions to the question, but one well known one is to the effect that what justifies the inference is that we have reasoned this way in the past, and the result has (usually) been correct; so it is (likely to be) correct this time. In other words, induction is itself used to justify induction. The standard, and entirely reasonable, objection to this thought is that such a justification is clearly question-begging.

Be that as it may, this issue of circularity is quite different from the issue of circularity we face here. The question is not one of how abduction itself is to be justified, but of what the best theory of abduction is. In other words, the question concerns the justification for a *theory* of abduction.

One way to bring the point home is as follows. In her discussion of Dummett's essay 'The Justification of Deduction',[14] Haack points out that questions similar to that posed by the justification of induction are posed by the justification of deduction as well.[15] The situation concerning both is the same. Dummett himself draws an important distinction between a *suasive* argument and an *explanatory* argument. A suasive argument is an argument which will justify accepting the conclusion if one does not already do so. A suasive deductive argument for deduction, or inductive argument for induction begs the question, and so fails in this regard. The same is true of an abductive justification of abduction. However, an explanatory argument assumes that a form of inference is correct, and explains how and why it is so. A deductive explanatory argument for deductive inferences—as found, for example, in standard soundness arguments in metalogic—does not beg the question; neither does an inductive explanatory argument of induction. What we are dealing with concerning abduction is finding the best theory which explains how and why it works. In the same

[12] I note, in this context, a very interesting paper by Millson and Straßer (2019) . They give a theory of the formal properties of the connective 'that A is the best explanation that B'. As such, it provides a constraint on what any account of the relationship delivered by a theory of abduction must satisfy. As they point out, however (p. 5), this in not a theory of abduction, but, if correct, something which provides a necessary condition for any adequate theory.

[13] For a general discussion of this, see Henderson (2018).

[14] Dummett (1978).

[15] Haack (1982).

way, then, using abduction to determine what follows from what abductively begs no questions.

7 The real problem of circularity

So the problem of circularity we face in the present context is not one of attempting an abductive justification of abduction. The problem, rather, is this.

Let us suppose, to keep things simple, that we have two theories of abduction on the table, T_1 and T_2. There will be a bunch of data points: judgments about some good abductions and some bad abductions. Thus, in the simple abduction of Sect. 3, that the car had run out of fuel was the best conclusion; that there had been a simultaneous failure of the fuel gauge and the fuel injector would not be. On a much more sophisticated level, we have many examples from the history of science when the scientific community came to accept one theory over another, and so recognised which was the correct abductive conclusion and which the incorrect one. T_1 and T_2 can be evaluated against this data.

Clearly, however, the result of an abductive inference may depend on which theory of abduction is deployed, and so on T_1 and T_2 themselves. This is where the circularity enters into matters. T_1 and T_2 may give different results, and we need to take this into account. Let us write $T \prec_{T''} T'$ to mean that T' is preferable to T, given the theory T''. There can be three possible outcomes of the two evaluations:

1. $T_1 \prec_{T_1} T_2$ and $T_1 \prec_{T_2} T_2$ (or $T_2 \prec_{T_1} T_1$ and $T_2 \prec_{T_2} T_1$)
2. $T_2 \prec_{T_1} T_1$ an $T_1 \prec_{T_2} T_2$
3. $T_1 \prec_{T_1} T_2$ and $T_2 \prec_{T_2} T_1$

We need, as it were, a meta-(non-deductive) inference of which these are the premises. What should the conclusion be?

In the first case, one of our two theories comes out best on both accounts. Without loss of generality, suppose this is T_2. This is the clearest of the three outcomes, and T_2 is correct conclusion (by a sort of principle of dominance). Moreover, I think that this is, in general the most likely scenario. Theories of abduction may well disagree on certain points, but given that they are working off generally agreed data about what examples of abduction are good, there is reason to believe that such differences will not affect the final outcome markedly.

In the second case, each theory comes out best by its own lights. What the conclusion should be in this situation is less clear. The obvious thought is that, absent further considerations, the correct conclusion is that $T_1 \vee T_2$. In other words, we should simply suspend judgment about which of the two is to be accepted. But another possibility is that if one of these theories is already accepted, that theory should be our conclusion. That is, we apply a principle of conservativeness. The onus of proof is on a new theory.[16]

[16] In the case of deductive logic there has been a well articulated received theory since Aristotle—though what this is has changed over time. In the case of non-deductive logic, I think it fair to say that this is not the case. Articulating a theory of non-deductive inference is a much more recent phenomenon. However, one might say that we have always had some inchoate theory of abduction, embedded in our inferential practices. Call it a "folk theory", if you like.

In the third case, each theory is best according to the other. Clearly, we still have a tie, in some sense, and absent new considerations, the appropriate conclusion might again be $T_1 \vee T_2$; we might just suspend judgment between T_1 and T_2. But now the situation is more complex, since, in an obvious sense, each theory is incoherent by its own lights. Both disjuncts seem problematic. Starting with either of these theories, will tell us to move to the other, which will, in turn, tell us to move back to the other. We will be forced into a game of rational ping pong. For this reason, conservativity in the most obvious sense is not an option. We can, however, apply conservativity in a slightly different way. Suppose that T_1 is the accepted theory. If $T_1 \prec_{T_1} T_2$ then the conclusion of our meta-inference is T_2 unless $T_2 \prec_{T_2} T_1$, in which case it is T_1.

The phenomenon we have uncovered here, is, in fact, not a novel one. Something analogous may arise in the case of the abductive choice of a deductive logic.[17] Suppose that the abductive theory is unproblematic. When choosing between two theories of deductive logic, L_1 and L_2, some deduction would appear to be necessary. Let us write $L \prec_{L''} L'$ to mean that L' is preferable to L, employing the deductive machinery provided by L''. We then have the same three options:

1. $L_1 \prec_{L_1} L_2$ and $L_1 \prec_{L_2} L_2$ (or $L_2 \prec_{L_1} L_1$ and $L_2 \prec_{L_2} L_1$)
2. $L_2 \prec_{L_1} L_1$ and $L_1 \prec_{L_2} L_2$
3. $L_1 \prec_{L_1} L_2$ and $L_2 \prec_{L_2} L_1$

Again, the first case is unproblematic; and given that the amount of deductive logic required is arguably pretty minimal (perhaps no more that some inferences involving simple arithmetic), this case will be the most usual. (Though it has at least been argued that some cases of the third kind are possible.[18])

In the case of deductive logic, the options countenanced with respect to abduction are, again, on the table.

8 A reply?

There is more to be said about the various possible options. I will turn to this in the next section, but first let me address some pertinent considerations raised by a referee of a previous draft.

The referee suggested that we can avoid the circularity involved (in the non-deductive case) because we do not have to deploy a theory of abduction to make an abduction. We already have a practice of abduction, and we can simply employ this. Now, we certainly do have a practice of abduction, just as we have a practice of deduction. But it should surely be the case that this practice is informed by our best theory. We should infer in a way that our best theory tell us is wrong?! So assuming that our practice is so informed, this amounts to implementing the conservativity option.

The referee also suggested that the point of formulating a theory of logical validity (abductive, but I assume that they think it applies to deductive too) is to "codify"

[17] For a discussion, see Priest (2016), §3.4.

[18] See Woods (2019). Woods notes that the problem can be solved by enforcing conservativity (p. 322), though he suggests that this applies to certain kinds of what he calls 'whole theory' comparison.

our inferential practices. Formulating a theory in this way may help us get rid of performance errors.

Now, matters are more nuanced than this. It is certainly true that our practices will provide us with examples of abductive inferences which appear to be correct or incorrect. These will feed into the data against which our theory is judged. However, all data is fallible, and a good theory may well overturn some of this data. Nor is this simply a matter of correcting performance errors. To see this, merely consider the following. (I use an example from deductive logic, since it is more familiar. But the point could equally be applied to non-deductive reasoning.) I think it fair to say that inferential practice in mathematics before Brouwer was not intuitionistic. Let us call it classical. Suppose we were to became rationally persuaded by Brouwer (or Dummett or someone else) that this practice was wrong. (I'm not saying we should.) Then the rational thing to do would be to revise our practice and infer according to intuitionist logic. Nor were the applications of Excluded Middle made before that simply performance errors. Aspects of the practice as such were wrong.

Finally, the referee notes the fact that different theories may tell us that different things are performance errors. In that case, they say, we should suspend judgment till more evidence comes forward. Though not for the reasons the referee gives, suspending judgment is a possibility I have already noted.

9 Two final observations

Let me end with two final points. We have, till now, been considering the case where we have a choice between two theories. But at least in principle matters could be more complex, since we may have more than two.

Suppose that we have a bunch of abductive theories, $\mathfrak{T} = \{T_i : i \in I\}$, on the table. We have to choose between them. There will then be a corresponding bunch of relations $T \prec_{T_i} T'$. If the evaluation of each theory delivers a numerical magnitude, then these will at least be finite linear orders, which makes matters slightly more tractable. But we still face the problem of how to determine which T_i, if any, is best, given these orderings.

One might expect help to come from voting theory, which deals with the aggregation of a bunch of preference rankings[19]. And perhaps it does. However, matters are still more complex. There is, as far as I am aware, no issue of incoherence of the kind we have met to be faced in voting. As we have seen, in theory choice, the chosen theory may not be best by its own lights. Accepting it therefore seems to betoken a failure of rationality. By contrast, in an election, if *a* is elected, and *a* is not *a*'s own preferred candidate, *a* may be irrational to accept election, but there is no failure of rationality in the process.

Though the multiple-choice situation is certainly a theoretical possibility, I think that in practice it will not arise often. As historians of science such as Kuhn and Laudan have stressed, a new theory tends to be produced in response to long-standing

[19] On voting theory, see Pacuit (2019)

problems in an old theory.[20] We are then simply faced with a binary choice. Be that as it may, one cannot ignore the more complex situation as a theoretical possibility.

Second observation. We have seen till now two ways of dealing with problematic cases. One is to infer a disjunction of theories, and so, in effect, suspending judgment on which theory is correct. The other was to effect some version of conservativity, inferring the old theory unless certain conditions are satisfied. However, there is another possibility that bears serious consideration—that there is no valid inference concerning which theory to accept: there is (assuming there to be no other considerations) simply no fact of the matter as to what ought theory ought to be accepted.

We are dealing with a certain kind of norms: those of rationality. Now, systems of norms can be can fail to determine some things. Consider the following examples. We play a simple game. We take it in turns to cut a pack of cards. If a red card is shown, I pay you $1. If a black card shows up, you pay me $1. After playing the game for 10 minutes, we cut the pack and a Joker turns up. (Maybe it's red and black.) The rules of the game do not determine what should be done– but could be changed to do so: no one pays anything; the person who cuts pays; the person who was paid last time pays this time.

Real-life situations of this kind can occur in laws and other kinds of regulations, though concrete examples may be more contentious. The constitution of the United States says that if the president dies, the vice president becomes president. If both die together, it is up to Congress to determine who assumes presidential responsibilities. But what should happen if Congress itself cannot function (perhaps due to a nuclear terrorist attack in Washington) is not specified. So the constitution does not determine who is president in this situation. Congress has made various determinations from time to time, but the succession lists are very finite, and if no person on the list is alive, there is still an indeterminacy in the law.[21]

These examples concern norms of games, laws, and regulations, not norms of rationality. But they make the point: systems of norms can just leave matters undetermined. There is, as far as I can see, no reason why norms of rationality must determine what it is rational to do in every situation—especially unusual ones. Maybe this is so in our abductive case.

10 Conclusion

In this paper we have been looking at the rational choice of a theory of abduction. If one is an abductivist about deductive logic, then, I have argued, one should be an abductivist about abduction itself. Clearly this gives rise to a circularity, and this circularity poses problems. The problems are not where one might have expected them

[20] Kuhn (1962) and Laudan (1977).

[21] An example of a quite different kind is the following. Most sports are divided into men's and women's competitions. There have recently been a number of cases concerning whether, after transgender surgery, a person can compete in a sport of their new gender. Prior to a ruling by the appropriate body, there is no determinate answer to the question. (The International Olympics Committee ruled on the matter in 2003). Such rulings are necessary precisely because the notions of male and female are open textured, in the sense of Waismann. That is, the old concepts have no clear application in quite novel situations. See, e.g., Shapiro and Roberts (2019).

if one is familiar with discussions of inductive justifications of induction. Rather, they arise due to the fact that different theories of abduction may well not deliver a uniform verdict on the matter; different theories may even rank each other better. We noted some possible responses to these problematic situation, but the aim of this paper has not been to advocate any one of them. The situation is novel enough to require a good deal of further thought. Suffice it that this paper has put the matter on the agenda.[22]

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[22] This paper is a descendent of talks given at the University of Sydney, August 2019, and at the CUNY/Bergen Workshop on Anti-Exceptionalism about Logic, New York, September 2019. Many thanks go to those present on these occasions for their very helpful comments and suggestions, which helped me to see a number of things more clearly. Thanks also go to two anonymous referees of this journal for similar reasons.