The Uses of Truth: Is There Room for Reconciliation of Factivist and Non-factivist Accounts of Scientific Understanding?

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Abstract: One of the most lively debates on scientific understanding is standardly presented as a controversy between the so-called factivists, who argue that understanding implies truth, and the non-factivists whose position is that truth is neither necessary nor sufficient for understanding. A closer look at the debate, however, reveals that the borderline between factivism and non-factivism is not as clear-cut as it looks at first glance. Some of those who claim to be quasi-factivists come suspiciously close to the position of their opponents, the non-factivist, from whom they pretend to differ. The non-factivist in turn acknowledge that some sort of 'answering to the facts' is indispensable for understanding. This paper discusses an example of convergence of the initially rival positions in the debate on understanding and truth: the use of the same substitute for truth by the quasi-factivist Kareem Khalifa and the non-factivists Henk de Regt and Victor Gijsbers. It is argued that the use of 'effectiveness' as a substitute for truth by both parties is not an occasional coincidence of terms, it rather speaks about a deeper similarity which have important implications for understanding the essential features of scientific understanding.

Keywords: scientific understanding**,** factivist vs. non-factivist accounts of understanding, understanding and truth, effectiveness, inferential account of understanding;

1. Introduction

One of the most lively debates on scientific understanding in the recent years is about the relation between understanding and truth. Although the vast majority of the participants in the debate tend to buy the idea that 'answering to the facts', i.e. some sort of truthfulness, is essential for genuine understanding (Baumberger, Beisbart & Brun, 2017) the uses and the more detailed elaborations of this idea are broadly perceived as divergent[1]. The so-called factivists, and the quasi-factivists[2], argue that insofar as understanding implies truth, the understanding providers, whatever they are (theories, models or any other kind of representation), should contain some truth or should be analyzable in terms of truth. At the same time, their critics, the so-called non-factivists[3], claim that being true (true enough, or partially true) is neither sufficient nor even necessary for an

[1] For recent reviews of the debate, which adheres to its standard presentation, see (Baumberger, Beisbart & Brun, 2017) and (De Regt & Baumberger, 2019). The view that philosophers are 'deeply divided over the connection between understanding and the facts' is also supported by Hannon (2021).

[2] Well-known factivists (or rather quasi-factivists) are J. Kvanvig (2003), S. Grimm (2006), D. Pritchard (2007), M. Strevens (2008), M. Mizrahi (2012), K. Khalifa (2017). The terms 'quasi-factivism', 'quasi-factivists' and 'quasi-factive understanding' have been coined by K. Khalifa (2017).

[3] Among the most famous defenders of non-factivism are L. Zagrebski (2001), C. Elgin (2004; 2009; 2017), A. Bokulich (2008), W. Riggs (2009), H. de Regt (2015), A. Potochnik (2017).

understanding provider to yield understanding[4]. The arguments of the non-factivists usually build on examples showing that non-linguistic representations (e.g. material models, which are not truth-apt), false theories, incompatible models as well as models containing idealizations and fictions, are able to provide understanding. These examples have been seen as the biggest challenge for the factivists, and for the quasi-factivists. The biggest challenge for the non-factivists is the question why arbitrary false constructions do not yield understanding. In recent years, however, the positions of factivists and non-factivists show a tendency to converge[5]. Although still insisting that understanding is not an epistemic aim, which is different and independent from the aim to find 'true answers to relevant questions' (Khalifa, 2020), some quasi-factivists like Kareem Khalifa has defended their veritist position by embracing a strategy, which is very close to the one, which some non-factivists have used to demonstrate that truth is neither necessary nor sufficient for understanding[6]. Both strategies make use of the term 'effectiveness' as a substitute for 'truth' and

[4] Applied to understanding, the term factivity was probably first used by C. Elgin (2004): 'Understanding is a cognitive success term but, in my view, not a factive' (Elgin, 2004, p. 120). Initially, the debate about the factivity of understanding was conducted mainly in epistemology (Kvanvig, 2003; Elgin, 2004; Elgin, 2009), where examples from the history of science were sporadically discussed. In the philosophy of science, the label 'factivity' gradually began to be used thanks to H. de Regt (2015), see also (Bangu, 2017).

[5] The presence of this tendency does not mean that no attempts are made to defend 'strictly factive theories of understanding' – see e.g. (Rice, 2016), (Lawler, 2021), (Ross, 2021) or non-factive theories – see (Doyle et al., 2019).

[6] The tendency towards convergence of the positions of factivists and non-factivists has not been left unnoticed by the representatives of these positions. Thus, for example, H. de Regt and V. Gijsbers make

boil down to the view that an understanding providing representation must be 'effective' in order to serve the function it does.

The aim of this paper is to analyze the uses of 'effectiveness' by the non-factivists H. de Regt and V. Gijsbers and the quasi-factivist K. Khalifa, and to point to some important implications of this analysis for more general questions concerning the nature of scientific understanding.

The paper has the following structure. In sections 2 and 3 H. de Regt & V. Gijsbers' (2017) and K. Khalifa's (2017) uses of 'effectiveness' are outlined. Then in section 4 the similarities and dissimilarities between the two allegedly different notions of effectiveness are discussed and it is shown that these are easier to see when the uses of 'effectiveness' are analyzed in terms of the notion of inference. In the 5th section the inferential construal of 'effectiveness' is expanded and its implications for some of the questions, which set the agenda of the debate on scientific understanding are traced.

2. Effectiveness as a Substitute for Truth in a Non-factivist Account of Scientific Understanding (de Regt & Gijsbers, 2017)

In their 2017 paper 'How false theories can yield genuine understanding' H. de Regt and V. Gijsbers introduce the notion of 'effectiveness' in order to explain why some false theories (e.g. phlogiston theory, Newtonian theory of gravitation, fluid models of energy and electricity) are able to provide understanding and why other false theories (e.g. astrology, the theory suggesting that the planets are pushed by angels) cannot do that. H. De Regt and V. Gijsbers' short answer is the

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the remark that in their attempts to save the veridicality condition some of the proponents of this condition 'come close enough' to the non-veridicalist notion of understanding (de Regt & Gijsbers, 2017, p. 54).

following: the former theories are effective, while the latter are not. De Regt and Gijsbers argue that what they call 'the effectiveness condition for understanding' should replace the nowadays broadly accepted 'veridicality condition' which states that 'only representational devices that satisfy a criterion of representational veridicality can grant understanding' (de Regt & Gijsbers, 2017, p. 52)[7]. H. De Regt and V. Gijsbers define 'effectiveness' as 'the tendency to produce useful scientific outcomes of certain kind', including 'correct predictions, successful practical applications and fruitful ideas for further research' (de Regt & Gijsbers, 2017, p. 51). In support of their proposal, H. De Regt and V. Gijsbers provide both systematic arguments and historical case studies (of the phlogiston theory, Newtonian theory of gravitation and substance (fluid) models of heat, energy and electricity). They argue that while it is controversial whether the veridicality condition is satisfied in the discussed historical examples, the fulfillment of the effectiveness condition is beyond any doubt as far as in all three examples the alleged understanding providers had led to 'correct predictions, successful practical applications and fruitful ideas for further research'. For example, the phlogiston theory, which today is considered completely wrong, was used in the 18th century to explain a large set of phenomena including

[7] By using the term 'veridicality' instead of 'factivity' H. de Regt and V. Gijsbers broaden the scope of their attack. Thus a target of their criticism become not only the factivists who reduce understanding to propositional knowledge, which is truth-apt, but also those who adopt a broader notion of truthfulness (e.g. 'representational accuracy', 'getting it right' etc.), which is applicable to non-propositional representational devises (e.g. material models, diagrams etc.) that are broadly taken to provide understanding. H. De Regt and V. Gijsbers argue that replacing truth by any broader notion of representational adequacy does not strengthen the factivist position as far as there are examples of understanding providers, which do not satisfy even the most liberal adequacy condition.

combustion, calcination of metals and reduction (of calx to metal) and inspired experiments which eventually led to the isolation of hydrogen (by H. Cavendish in 1766) and oxygen (by J. Priestly in 1744). H. De Regt and V. Gijsbers do not provide any systematic analysis of the terms they use to denote the criteria for effectiveness, i.e. the terms 'correct predictions', 'successful practical applications' and 'fruitful ideas for further research'. One is left to infer the denotations of these terms from their uses in the accounts of the discussed historical examples. The 'effectiveness' of the General Theory of Relativity (GTR), for example, is associated with the 'correct predictions' of the deflection of light by the Sun (confirmed by Eddington in 1918) and the gravitational redshift (confirmed in the 1960s). These predictions, according to H. De Regt and V. Gijsbers, also played the role of 'fruitful ideas for further research' insofar as they had inspired the research, which eventually led to the observation of the predicted phenomena. As an example of the 'successful practical applications' of General Theory of Relativity H. de Regt and V. Gijsbers point out the Global Positioning System (GPS) which takes into account 'relativistic corrections' in order to guarantee that the data it provides are correct (de Regt & Gijsbers, 2017, p. 68).

3. Effectiveness as a Substitute for Truth in a Quasi-factivist Account of Scientific Understanding (Khalifa, 2017)

Kareem Khalifa (2017) introduces 'effectiveness' as part of his 'expanded' concept of knowledge which he has launched as a solution of the problems raised by the so called 'idealization argument' against factivism about scientific understanding. Briefly stated (and oversimplifying it a bit), the idealization argument goes as follows: (1) Some idealizations yield understanding. (2) All idealizations are false representations. Therefore, (3) Some false representations yield understanding. To meet the challenge of the 'idealization argument', K. Khalifa makes the

proposal to 'expand' the traditional concept of knowledge, which defines 'knowledge' as 'justified true belief', by introducing 'acceptance'[8] as a substitute for 'belief', and 'effectiveness' as a substitute for 'truth'. He does not formulate the criteria for 'effectiveness' directly but announce the requirements for an idealization to be 'scientifically acceptable': it must lead to predictions of novel phenomena, to answers of why-questions (asked by a particular audience), and to (effective) control (i.e. to allow for successful manipulations and interventions in areas of practical interest) (Khalifa, 2017, pp. 171-172). Given K. Khalifa's formula that 'effectiveness is to acceptance as truth is to belief' (Khalifa, 2017, p. 169) we may assume that the conditions which justify the 'acceptance' of an idealization are the same which justify its 'effectiveness' just as the conditions which justify our belief that *X* are the same which justify the statement '*X* is true'.

Like H. de Regt and V. Gijsbers, K. Khalifa does not give detailed descriptions of the requirements that a representation must satisfy in order to be declared 'scientifically acceptable'. Again, one is left to infer the denotations of 'predictions of novel phenomena', 'answers of why-questions', and 'control' from their uses in the discussions over particular examples. The example, which Khalifa uses to illustrate how his expanded notion of knowledge works, is about the explanation of the Ideal Gas Law by the Kinetic Theory of Gases[9]. This explanation brings understanding, Khalifa

[8] The idea to use 'acceptance' as a substitute for 'belief' is not new, as K. Khalifa himself admits. He has borrowed it from Jonathan Cohen (1992) and contrasts his own use of 'acceptance' with that of Katherine Elgin (2004).

[9] The Ideal Gas Law (P.V = n.R.T) was first formulated by E. Clapeyron in 1834 as a generalization of the empirical Boyle's law, Charles' law, Avogadro's law and Gay-Lussac's law. Later the Ideal Gas Law was theoretically derived from the principles of the Kinetic Theory of Gases. This derivation was made possible due to the mentioned above simplifying assumptions about the mass and the dynamic properties of the

states, because the idealizations which it is based on (the assumptions that the molecules of the ideal gas are mass points which have no volume, and that these molecules are also perfectly elastic and exert pressure on the walls of the container but do not interact with each other) are 'scientifically acceptable', and they are scientifically acceptable because they lead to important predictions, answer important why-questions and help us to control (to manipulate in the desired direction) the behavior of real gases located in closed containers.

4. Similarities and Dissimilarities Between the Quasi-factivist and the Non-factivist Uses of Effectiveness

Does 'effectiveness' denote the same things in H. de Regt & V. Gijsbers and K. Khalifa's accounts? A first glance reveals that in both accounts, 'effectiveness' is associated with correct predictions. Then H. de Regt & V. Gijsbers add to the manifestations of 'effectiveness' also 'successful practical applications' and 'fruitful ideas for further research' while Khalifa adds 'answers to why-questions' and 'control'. How essential is the discrepancy between 'successful practical applications' and 'fruitful ideas for further research' on the one hand and 'answers to why-questions' and 'control' on the other? To answer this question, a construal of the mentioned criteria in terms of the notion of inference is suggested.

Although philosophers like Carl Hempel (1965) have argued that all predictions are inferential in nature, the received view today is that predictions are 'generated' and that 'the generative process

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molecules of the ideal gas. These simplifying assumptions are literary false, nevertheless together with the principles of the Kinetic Theory of Gases they provide us with understanding of the Ideal Gas Law and the phenomena which it describes.

may be purely logical but it may not be' (Douglas, 2009, p. 445). Without insisting that all predictions are reducible to inference, here it is proposed to embrace a weaker version of Hempelian inferentialism, according to which any prediction can be analyzed in terms of inference, if 'inference' is construed broadly enough so as to include not only logical inferences (deductive and inductive) but also mathematical calculations as well as the so-called material inferences[10]. In any case, the examples of correct predictions given by both H. de Regt and V. Gijsbers and by K. Khalifa could be easily analyzed in terms of inference. For example, the predictions of the General Theory of Relativity are in fact deductions from the theory and certain additional assumptions. The same is true for the predictions of the Ideal Gas Law. But what about the other demonstrations of 'effectiveness', which H. de Regt and V. Gijsbers labeled as 'successful practical applications' and 'fruitful ideas for further research' and K. Khalifa called 'answers to why-questions' and 'control'? To see how these, too, could be analyzed in terms of inference let's go back to the examples which have been used to illustrate the demonstration of 'effectiveness' in both accounts of scientific understanding. The indispensable role of inferences for both 'successful practical applications' and 'fruitful ideas for further research' is best seen on the example of the General Theory of Relativity provided by H. de Regt & V. Gijsbers. The 'fruitful ideas for further research', which the General Theory of Relativity suggested are in fact based on the predictions, which were generated, i.e. inferred, from it: these are the prediction of the deflection of light by the Sun, which

[10] This weaker inferentialism about predictions is compatible with Salmon's view that all predictions 'construed broadly enough … include inference from the observed to the unobserved' (Salmon, 1978, p. 684). Following W. Sellars (1953) and R. Brandom (1994; 2000), 'material inferences' are called the inferences the validity of which depends on the meanings of the concepts that appear in the premises. See also I. Brigandt (2010).

inspired Eddington to undertake an expedition in order to confirm this prediction, and the prediction of the gravitational redshift, which formed the research agenda of several generations of physicists (Hetherington, 1980; Valente, 2018). The 'successful practical application' of the General Theory of Relativity in the design of the Global Positioning System (GPS) is also based on the prediction of the redshift. Without taking into account the redshift effect, the data obtained by the Global Positioning System would be significantly incorrect (Ashby, 2002).

Like predictions, 'the answers of why-questions' are also 'generated' rather than directly inferred from the explanatory representation (a theory or a model). Again, we can apply the same weak inferentialist assumption that although not reducible to inferences, the explanatory answers of why-questions could be analyzed in terms of inference if the latter is construed broadly enough. When discussing the context sensitivity of the process of answering why-questions K. Khalifa mentions the role of 'inferential capacities'. If the inferential capacities of those who suggest answers to explanatory questions matter, then it is difficult to argue against the role of inferences in the generation of explanatory answers. Some of these explanatory answers also allow for control over the explained phenomena. Following J. Woodward (2003), K. Khalifa stresses the practical usefulness of causal explanations, or causal information in general. Indeed, the knowledge that *A* is causally related to *B*, allows us to infer that by manipulating *A* we could also change *B*. The latter conclusion in turn allows us to build a plan for action if changing *B* is in the scope of our interests.

In short, the criteria for 'effectiveness' proposed by H. de Regt and V. Gijsbers on the one hand, and those proposed by K. Khalifa on the other, do not seem significantly different anymore if we construe them in terms of the notion of inference. This construal makes clear that the seemingly divergent criteria for 'effectiveness' refer to the same inferential capacities of the understanding

provider. The latter suggest a way to broadening the scope of the inferential analysis beyond the uses of 'effectiveness'. The implications of such a broadening are discussed in the next section.

5. Understanding and Inference

It was shown in the previous section that the scientific activities which are seen as manifestations of the 'effectiveness' of an understanding provider either include inferences or have as predecessors other activities which include inferences – see Table 1 for a summary of the results of this analysis.

Table 1: Manifestations of effectiveness and their relations to inference

(1) novel predictions	Predictions are either inferences or include inference.
(2) fruitful ideas for further research	As far as the new ideas are based on novel predictions (1), inference plays an indispensable role in them as well.
(3) useful practical applications	As far as practical applications are also based on the generated predictions (1), inference plays an indispensable role in them as well.
(4) answers of why-questions (explanations)	The role of inference in explanations is best seen on the example of causal explanations: we value these explanations because they allow us to infer that if *A* is causally related to *B*, than a manipulation of *A* could lead to a change in *B*.
(5) (effective) control	The effective control is made possible by the establishment of causal relations between the objects which we want to control, i.e. it is based on (4).

The obtained results suggest the following simple argument: If one or another sort of inference is indispensable for the manifestations of 'effectiveness' of a representational device, and if we agree that 'effectiveness' is a necessary condition for understanding, we should also agree that there is a necessary connection between the understanding we get by a given representational device and its inferential capacities[11]. This conclusion has important implications for the debate on factivity of understanding as well as for some broader issues related to scientific understanding.

At first glance, the proposed inferential account of understanding seems to favor the non-factivist view of scientific understanding insofar as it gets rid of the requirement to satisfy any sort of 'veridicality' of the understanding providing representational device. On the other hand, however, a reliable inferential success could hardly be achieved if the inferential premises are not true (or 'true enough', or 'partially true' etc.). A non-factivist can avoid this objection by postulating that the understanding providing devices do not play the role of premises in an understanding providing inference but the role of an 'inference ticket'[12], i.e. the role of an inferential rule or a schema, which is not truth-apt. However, even if we buy this proposal, some true premises are still needed at least in the form of initial conditions, to which the 'inference-ticket' (i.e. the representational device possessing certain inferential capacities) to be applied. In this case, however, it is not clear to what extent it is fair to declare as the bearer of understanding only the representational device having inferential capacities and not the representational device taken together with the initial conditions (the premises), which we have used to make the inferences manifesting the achievement of understanding. In short, the inferential account of understanding does not seem to be closely

[11] The use of the term 'inferential capacities' here is similar to that in (Suárez, 2004).

[12] The term 'inference ticket' is introduced by G. Ryle (1949) and it is used here with the meaning, which Ryle gives it.

associated with either factivism or non-factivism, it rather proposes a way to reconciliation of both views in a single uncontroversial theory.

The inferential construal of effectiveness also helps to recognize that the position of K. Khalifa on the one hand and that of H. de Regt and V. Gijsbers on the other, are not unique. Although not using the term 'effectiveness' in their way, other authors (e.g. Elgin, 2017; Strevens, 2017) have come very close to similar ideas.

The implications of the inferential account of understanding go beyond the debate on the factivity of scientific understanding. Briefly stated, some of these implications are as follows:

i) The inferential analysis of 'effectiveness' reveals that the epistemic merits of a representational device (e.g. the correct predictions which we are able to generate with it) and its non-epistemic merits (e.g. its effective use in various practical applications) have a common ground – the inferential capacities of the representational device.

ii) The inferential analysis of causal explanations explains why they are often valued more than other explanations: this is due to the important inferences, which these explanations allow for.

iii) The inferential account of understanding stresses the importance of training all sorts of inferential skills (general analytical skills as well as the skills to apply specific inferential technics in a specific area of science) for all those who want, or who are expected, to advance either theoretical understanding or applied research.

All this presents the inferential approach as setting a framework that allows many ideas to be generated for future fruitful studies of scientific understanding.

6. Concluding remarks

Initially emerging as opposites, the positions of the so-called factivists and the non-factivists about the relation between understanding and truth have recently shown a clear tendency to converge. A sign of this convergence is the use of the same substitute for truth, the concept of effectiveness, by certain eminent representatives of both camps. The analysis of the proposed criteria for effectiveness in terms of the notion of inference allows us to reveal that all manifestations of effectiveness by an understanding provider either include inferences or have as a necessary predecessor an activity that includes inferences. This result leads to the following simple argument: If a certain kind of inference is indispensable for the manifestations of 'effectiveness' of a representational device, and if we agree that 'effectiveness' is a necessary condition for understanding, we should also agree that there is a necessary connection between the understanding we get by a given representational device and its inferential capacities. If we buy the conclusion of this argument, we should also take seriously the following: Some of the premises of the inferences allowed by an understanding providing representational device must be true (partially true, or true enough) if we want this device to be effective, i.e. to reliably lead to correct predictions, fruitful ideas for further research or successful practical applications. In the same time, it is not the representational device that must satisfies the veridicality condition as the representational device might well serve as an 'inference ticket' establishing inferential connections between certain true (partially true, or true enough) premises and other true (partially true, or true enough) conclusions, the latter playing the role of novel predictions, answers of important why-questions, fruitful ideas for further research or a basis for successful practical applications. In this way the proposed inferential account of understanding could be seen as a mean for reconciliation in a single uncontroversial theory of the most valuable insights of factivism and

non-factivism about scientific understanding. Some implications of the proposed inferential analysis of effectiveness and understanding, which go beyond the factivity debate, are worth mentioning: (i) the epistemic and the non-epistemic merits of a representational device seem to have a common ground – the inferential capacities of this device; (ii) the causal explanations are valued more than other explanations because of the important inferences, which they allow for; (iii) training all sorts of inferential skills (general analytical skills as well as skills to apply specific inferential technics used in a specific area of science) is extremely important for all those who want, or who are expected, to advance either theoretical understanding, or applied research. Due to these implications, it is expected that the proposed inferential approach will noticeably enrich the research agenda of those who are interested in scientific understanding by providing them with ideas for further studies, that can prove fruitful.

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