"Understanding, explanation, and intelligibility. A review of *Understanding Scientific Understanding* by Henk de Regt" for *Metascience* by Insa Lawler

This is a post-peer-review, pre-copyedit version of an article published in *Metascience*. The final authenticated version is available online at http://dx.doi.org/10.1007/s11016-018-0358-3.

Science aims at understanding phenomena. One natural candidate for illuminating scientific understanding is *explanation*. Certainly, an explanation could contribute to someone's understanding. But it is controversial whether explanations must produce understanding, whether understanding always involves some explanation, and whether there can be understanding without explanation. In his book *Understanding Scientific Understanding* (2017, OUP), Henk de Regt sheds light on the relation between explanation and understanding by offering a unique account of scientific understanding, with an eye on *how* understanding is achieved. This account – which draws from two decades of his research – is presented in a form that is pleasant to read, accessible to a variety of readers, embedded into the longstanding philosophical debate about scientific explanations, and buttressed with numerous examples and three in-depth case studies from the history of physics. Although de Regt every so often points to examples from other sciences, such as biology, his account is tailored to physics. At best, he convinces his readers that it generalizes to other natural sciences. But whether it can accommodate social sciences or economics is not evident, as de Regt himself admits (pp. 11, 261).

de Regt's account follows an approach that considers the analysis of *scientific practice* to be the driving source of philosophical accounts of science (cf. ch. 1.2, 8.3). He aims at a *rational reconstruction* of scientists' criteria for understanding, based on and evaluated by historical studies of physics. Although de Regt only mentions it in passing, his account of understanding is primarily concerned with understanding *why* or *explanatory* understanding (cf. fn. 1 on p. 2, p. 96). Other forms of understanding, such as understanding *how* or so-called *objectual* understanding are not tackled. Another constraint is that de Regt focuses on what he calls the *macro* level (science as a whole) and *meso* level (scientific communities) instead of the *micro* level (scientists) (p. 90). He aims at analyzing what it means for a scientific community, rather than a single subject, to achieve understanding. Moreover, he is not concerned with the *phenomenology* of understanding (pp. 20-23). According to de Regt, understanding why always involves some explanation why *p*; there is no understanding why without explanation. Yet, there could be explanations that do not provide understanding; these are explanations that lack an *intelligibility* feature (p. 92):

Criterion of Understanding Phenomena (CUP): A phenomenon P is understood scientifically if and only if there is an explanation of P that is based on an intelligible theory T and conforms to the basic epistemic values of empirical adequacy and internal consistency.

In other words, a phenomenon is understood iff there is an explanation that is (i) based on an intelligible theory, (ii) empirically adequate, (iii) and internally consistent. According to de Regt, explanations are arguments in a broad sense (pp. 24-25) and he argues in favor of *pluralism* about explanations (chapter 3). de Regt does not say much about the last two constraints, but takes it to be rather self-evident that any understanding providing explanation features them, although perhaps to different extents (pp. 36-38, 93). His focus lies on the *intelligibility* criterion, which is *intersubjectively* defined (p. 40):

Intelligibility: the value that scientists attribute to the cluster of qualities of a theory (in one or more of its representations) that facilitate the use of the theory.

Intelligibility is what one could call a *cluster concept*, i.e., a concept whose application does not require that *all* characterizing features are fulfilled. According to de Regt, the prime qualities are visualizability, appeal to causes, and unification (p. 56). Other qualities are simplicity, continuity, etc. The main use of a theory (regarding understanding why) is the construction of explanatory models of the phenomena in question. de Regt also offers an instance of an intelligibility criterion (p. 102):

Criterion for the Intelligibility of Theories (CIT_1): A scientific theory T (in one or more of its representations) is intelligible for scientists (in context C) if they can recognize the qualitatively characteristic consequences of T without performing exact calculations.

Importantly, this is just one criterion. Theories can be intelligible in other ways. In fact, according to de Regt, intelligibility is not just a cluster concept; it is a concept whose characterizing features can vary across contexts and scientific communities (meso level). Intelligibility is a *context-sensitive* notion. For instance, whether visualizability is part of the cluster or not varies among communities. This renders understanding context-sensitive, too. de Regt underpins the context-sensitivity claim and CIT_1 with the aid of detailed case studies of research on gravity (ch. 5), the use of mechanical models in nineteenth-century physics (ch. 6), and the role of visualizability in quantum physics (ch. 7).

de Regt's proposal to provide a *unified* notion of understanding in terms of intelligibility is promising. It also seems to be plausible that intelligibility is a cluster concept that varies across scientific communities, diachronically and synchronically. In my opinion, however, de Regt's account faces a couple of challenges. Some of these have been pointed out by Kareem Khalifa (2017), such as the issue that his notion of a theory (which allows for a collection of loosely circumscribed theoretical

principles) and his notion of being based on a theory (which allows for a theory to just play *some* constraining role) are arguably too broad (pp. 97-98). I focus on additional issues.

First, the *object* of analysis needs to be better specified. He seems to conflate the question of what is required for *acquiring* understanding and the question of what understanding *consists* in: "But what does it mean to seek or to achieve such understanding? What exactly is scientific understanding? *This* is the question that this book aspires to answer" (p. 2, my italics). de Regt mainly tackles acquisition and CUP only provides (allegedly) necessary and together sufficient criteria for understanding (p. 95). At best, his rough characterization of understanding phenomena (UP) gestures towards an answer to the constitution question: "UP […] = having an adequate explanation of the phenomena" (p. 23). Yet, de Regt remains silent on what having explanations involves, at the micro, meso, or macro level.

Second, CUP does not seem to provide a sufficient criterion. The *existence* of an explanation might well be crucial for acquiring understanding, but it does not seem sufficient. As de Regt emphasizes, understanding is a 'three-term relation' (p. 19) between a phenomenon, an explanation, and a subject (be it an individual or subjects in a community). So, understanding must involve some subjects that take an epistemic stance toward the explanation. If de Regt wants to claim that the construction of an appropriate explanation already suffices for understanding, he needs to argue for it.

Third, and relatedly, CUP does not incorporate de Regt's claim that understanding requires *epistemic accessibility* (p. 84). Perhaps de Regt would like to maintain that someone must craft the understanding providing explanation. But then the question arises whether access for a single individual would be enough or whether the number of scientists depends on the group size, e.g., mainstream physicists vs. a group of pioneering physicists.

Fourth, de Regt claims that understanding can come in degrees (pp. 43, 135). However, he does not outline how his account could accommodate this claim. In their current forms, neither CUP nor the intelligibility characterization can accommodate degrees. Intelligibility might be analyzed as coming in degrees, but it is not clear whether degrees of understanding (if existent) are measurable in terms of intelligibility. It seems more natural to assume that the *content* of the understanding providing explanation is crucial; a richer explanation might lead to more understanding, etc.

Fifth, de Regt proposes a relationship between explanation and understanding that seems to contradict CUP. He claims that understanding a phenomenon is *the product* of explanations (e.g., pp. 45, 86, 96). However, if understanding is the *product* of explanations, there is no explanation without understanding. Yet, according to CUP, only explanations that fulfill the conditions (i)-(iii) can provide understanding. Perhaps de Regt endorses the weaker claim that understanding is a potential product

of explanations. He sometimes states that understanding is the *goal* (e.g., pp. 12, 25, 45), which would be compatible with a weaker claim. But if so, he should be clearer on this crucial claim.

Sixth, de Regt sells CIT_1 as a sufficient condition (cf. footnote 15 on p. 102). So, contra what he suggests elsewhere (pp. 101, 271), CIT_1 cannot be a *test* for whether or not a theory is intelligible, since it is not a *necessary* condition. More importantly, CIT_1 seems to describe a *manifestation* of, rather than a condition for, intelligibility. A *recognition* of a theory's consequences seems to be a manifestation of the facilitation of the use of that theory. Moreover, CIT_1 commits de Regt to claiming that citing a *correlation* can provide understanding (p. 122). If CIT_1 were just about manifestation, he need not to commit to such a controversial claim.

So, there seems to be need for further development of de Regt's account. Yet, it is undoubtedly an important contribution to the field. It involves many valuable insights, promising theses, and excellently crafted in-depth case studies.

Bibliography

Khalifa, Kareem (2017). Review of Henk de Regt's *Understanding Scientific Understanding*. In: Notre Dame Philosophical Reviews. https://ndpr.nd.edu/news/understanding-scientific-understanding/