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Does understanding solve problems?

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ABSTRACT: It is intuitive to think that understanding, at least in exemplary cases, solves problems. This has motivated a general view concerning the nature of understanding and its relation to problem-solving. In this text, I examine four reasons offered in favor of thinking that understanding solves problems. I argue that the reasons given are not conclusive. It is telling that all these reasons can be questioned because they explore different facets of understanding, phenomenal and epistemic alike, suggesting that no aspect essential to understanding necessarily involves problem-solving. I conclude by exploring the larger significance this fact might have for the nature of understanding.

KEY WORDS: Understanding, problem-solving, insights, puzzlement, creativity, expertise.

Introduction

What is understanding? We use the word in many different ways. Here are a few generalities to target the meaning I will explore. We might say someone understands how to dance when they can dance well. We understand what our interlocutors say when we know what they mean. We understand the pain a friend is going through when we can empathize with them. And we understand what we see when we can properly conceptualize the visual scene. In what follows, I put such uses aside and focus on *explanatory* understanding. This is the kind of understanding we get when we grasp an explanation of the phenomenon understood – or when we have all the needed pieces of information and are able to readily produce such an explanation.

Explanatory understanding, in turn, has been conceived in several ways. For instance, having an overall grasp of Euclidean geometry is one way to possess (*objectual*) understanding. I can understand *that* a murder has been committed without knowing why. I can understand and explain *why* birds chirp in the evening, or I can understand and explain *how* they manage to emit the sounds they do. All these seem to be distinct endeavors.

Nevertheless, it does not seem that the word "understanding" is merely equivocal across such uses, with nothing genuinely cognitive or epistemic in common. On the contrary, we often attribute understanding (of the explanatory or intellectual sort) without specifying which kind it is: understanding-of, understanding-that, understanding-how, or understanding-why. And we often take ourselves to be correct in making these attributions.

Our attributive practices call for explanation in terms of some unified conception of explanatory understanding. It is this unified phenomenon that I have in view. For instance, having an overall objectual grasp of Euclidean geometry often enables me to give explanations of *why* problems can be solved some way but not some other way, to know *that* some theorems apply and others not, and to know *how* to best construct a figure so that the solution to a problem becomes more apparent.

Does understanding, conceived this way, have any deep ties to problem-solving? We are often – but not always – puzzled. When we are puzzled for good reason, there is a problem we are tackling that we are puzzled *about*. When we understand something, we sometimes – perhaps always – solve just such a problem.

Here is an example. With a modicum of knowledge, we all understand why the sun rises every morning. This example is not as involved as it might seem. *Fully* understanding why the sun rises every morning might involve knowing a lot of astronomy and a little bit of its history. But, at a minimal level, knowing why the sun rises involves knowing only some principled facts about circular motion with a light source at a distance, plus some facts about how we use words – e.g., that the Earth rotates in 24 hours, alternating between night on the side of the Earth opposite to the Sun and day on the side of the Earth facing the Sun. Knowing this much is enough for a *minimal* understanding of why the sun rises every day. Most people are likely to have at least this minimal understanding.

Even children can understand why the sun rises every day. How do they do it? Suppose you take your child to the carousel (the biggest

one in the park). As the carousel starts spinning, the child always looks at you and waives when he can see you. But because the carousel is big, there will be seconds when the child won't be able to see you. When they come back around to the other side after each round, there will be a moment when they can see you again. That is very much like the sun rising; the key to the analogy is this. You are the Sun, the distant light source. The carousel is the Earth, which rotates. The child is the man waiting for dawn to spot the first ray of light. When the child cannot see you and waive, that is the analogue of night. When the child can see you and waive, that is the analogue of day. When the child stops being able to see you (because of the carousel walls), that is like dusk. And when the child first sees you again after a round, that is like dawn. The clearer view the child gets of you corresponds with the sun rising in the sky. And the more difficult view the child gets of you as the carousel spins corresponds with the sun slowly dipping beneath the horizon.

Examples like this one motivate a general view concerning the nature of understanding: in understanding, we solve problems. If this claim were true, that would vindicate an epistemology of *inquiry* for understanding according to which crucial to the states of mind that we characterize as understanding is the fact that they occur as part of an ongoing epistemic project in which the thinker is engaged. If it were true that understanding solves problems, we would also have the beginnings of an attempt at *unifying* different meanings of "understanding" because explanatory understanding could essentially only occur as part of a practical endeavor – the activity of solving problems.

Is it true that understanding solves problems?[1] I will examine four arguments offered in favor of thinking that understanding solves problems, and I will argue that each of them falls short of providing conclusive support for the claim in its full generality. This is significant because they explore different facets of understanding – phenomenal (experiences of insight and puzzlement) and epistemic (creativity and skill manifestation) – suggesting that no salient aspect of understanding can, by its very nature, be tied to problem-solving.[2]

[1] Of course, people rather than states of mind solve problems; the question is whether we, by understanding, solve problems.

[2] If we cannot definitively establish whether understanding solves problems, that leads to larger questions about how we should best characterize understanding. Does understanding something always consist in having true conceptions about it? Does understanding something require being able to endorse how we understand it in reflection? If we cannot justify answers to such questions in full generality (as it seems we cannot), then we face a deeper conceptual

1. Puzzlement and insight

Something puzzles you; it doesn't make sense, but then it hits you in a flash, and you come to understand how it works. This experience seems familiar; many have recognized it. Here is how Neil Cooper characterizes understanding:

> Consider the following Brentanoesque series. Perplexity – yearning for absent knowledge – hoping that it will be ours – the courage to attempt inquiry – the exhilaration of understanding at length attained. The members of this series show an intimate connection which leads us from a consciousness of cognitive need up to the enjoyment of the highest intellectual good. (Cooper 1994: 26)[3]

When coming to understand is a conscious experience, it is typically preceded by puzzlement, wondering, feeling unsure, or losing one's footing. When we figure out what puzzled us, we understand how to solve the problem bothering us. If the episodes in which we come to understand something new typically have a deep connection with the feeling of being puzzled, perhaps that is because, in understanding, we solve puzzles. How should we approach this line of thought?

Plainly, we don't need to undergo any noticeable subjective feeling *every* time we come to understand something. We often come to understand things even if we were not puzzled at the time nor had been puzzled by those facts before. In some cases we might feel puzzlement, and in others not. But if instances of *conscious* understanding typify or are paradigmatic for all instances of understanding, this worry is allayed. One outstanding trouble is that a phenomenological approach to understanding needs to provide *evidence* in favor of thinking conscious experience *is* central to understanding in the needed way. Anecdotes of puzzlement and relief at understanding are insufficient evidence to that effect.

No matter how questions of unconscious understanding are resolved, there is a deeper issue. Suppose we assumed that experiences of puzzlement are related to genuine problems, and experiences of understanding are related to genuine understanding – the ability to explain what is understood and to further use it in reasoning. We can only be warranted in making that assumption if our conscious experiences – of

problem. This is the problem of trying to epistemically characterize mental states in full generality. Failing to do in the case of understanding raises similar concerns for other epistemically significant states (belief, reflection, or "hot cognition"). I am grateful to an anonymous reviewer for probing the larger significance of the project in this text.

[3] Psychologist Alison Gopnik (1998: 110) concurs, pointing to how widespread our puzzlement is before we come to understand something.

puzzlement and of coming to understand – are *accurate*. Why think that our experiences of understanding are accurate? We often have a "feeling of knowing" (Koriat 2000) that is mistaken or misleading. It might be a flaw in our epistemic character to trust our experiences in a way that is not commensurate to their evidential status (assessed from a third-person perspective).

When inquiry goes well, perhaps understanding always follows puzzlement. But the tie could be broken. Do we *always* understand something only if inquiry starts with puzzlement? Could not figuring something out come out of the blue, without conscious prerequisites? Our minds wander, and we hit upon something that had not occurred to us before. "Aha!" we might think, "this is how things stand!" The bus and the hike are typical contexts when insights occur, moments in which it strikes us how things stand and how they are connected to each other (Nanay 2011). Puzzlement *might* arise on the bus or the hike trail alike, but it need not. Insights, and understanding, can occur serendipitously.

The thought that understanding solves problems raises the general issue of how understanding is conceived here. Does this include scientific, aesthetic, religious, and emotional understanding, or only some of them? Experiences of scientific insight and religious revelation might often feel similar (van Fraassen 1999). However, if we think that religious and scientific understanding share little if anything in common, it should follow that conscious experiences don't reveal much of the epistemic purport of understanding. If so, we should not expect an epistemic success like solving problems to follow from having conscious experiences of understanding or puzzlement.

2. Creativity

For Michael Lynch, the states of mind by which we understand phenomena around us – why it rained heavily yesterday, why Napoleon lost at Waterloo, why overstaying one's welcome is impolite – are states that are identified in terms of the moments in which they were acquired – moments of coming to understand.

> Coming to understand has a particular phenomenological appearance ... creative acts can be surprising even if they do not necessarily provoke that "aha" moment. … Even when coming to understand happens gradually over time it still feels "new" – as if you couldn't have understood it prior to that moment. (Lynch 2017: 203)

All moments of coming to understand involve "some degree of insight." Insights, for Lynch, are conscious experiences typified by the psychological novelty and surprise they elicit. It is precisely because of the novelty they bring that insights are *creative* and

> […] generative of valuable, not just psychologically novel ideas. Creative ideas are valuable to the person's cognitive workspace. They move things forward on the conceptual field on which they are currently playing […] they contribute to the problems at hand. (Lynch 2017: 202)

Creativity, in turns, means that the contents of insightful experiences advance our epistemic situation. They solve problems on our agenda, provide needed explanations, or help us draw salient inferences.

Lynch's discussion of creativity clarifies the relation between states of mind by which we understand and moments of coming to understand that produce such states. It also identifies *insights* as the kind of experience characteristic of coming to understand something,[4] and it begins to address the issue of how subjective and objective elements of understanding relate – how puzzlement expresses real puzzles, and how insights give rise to good solutions to those puzzles. Creativity is key here; our subjective insights are creative, and that means they objectively advance our epistemic situation.

Bracketing other worries, let us focus on how creativity is conceived here. Lynch follows Boden (2004) in distinguishing psychological from historical creativity. When creativity is purely psychological, we are reinventing the wheel, although doing so might be beneficial *for us*. When creativity is historical, we produce objectively new theories and explanations, new technologies and artifacts, thereby solving outstanding problems everyone faces.

Contra Lynch's line of thought, however, the distinction between psychological and historical creativity raises the question of phenomenal vs. epistemic all over again. If the novelty of insights is merely psychological, it is far from clear what epistemic benefit insights bring (a benefit we could not get, say, by deferring to expert testimony).[5] On the other

[4] Contra Lynch's identification of understanding in terms of moments of insight, notice that we typically have *streaks* of insights leading up to a new understanding of something. Consider only how the understanding of combustion went from being explained by phlogiston to being explained by oxidation (van Fraassen 1999). No *single* moment of insight could typify our understanding of combustion. This criticism applies to the phenomenological argument as well.

[5] Understanding seems to enjoy a cognitive ownership one could not likewise claim for knowledge gained by testimony. It is by one's own cognitive powers that one should be able to grasp an explanation of the phenomenon understood (Elgin 2007). However, in reaping

hand, if creativity is indeed historical, we run into trouble again, as *few* cases of subjective understanding are genuinely or historically creative. Either way, it is hard to see how purely subjective elements in understanding – e.g., "Aha!" experiences – could be responsible for objective epistemic *success* in solving problems.[6]

The creativity and phenomenological arguments for the thought that understanding solves problems fail for analogous reasons – for not adequately capturing the relation between subjective and objective elements in understanding. I will next consider two different arguments for supporting the thought that understanding solves problems. The arguments to follow share something important; they focus on elements in understanding that can be objectively evaluated. Thus, the kind of objection raised so far cannot be marshaled against them. Still, I will argue that those arguments fail for a different reason.

3. Phases of problem-solving

Mark Newman (2012, 2017) has discussed scientific understanding under two headings. First, he thinks, comes comprehension. This stage roughly corresponds with understanding-that. In comprehension, we conceptualize a phenomenon without *inquiring* into its causal structure.[7] Second comes theoretical understanding, or understanding-why. Not only do we have appropriate conceptions of the phenomenon into which we inquire, but we also grasp the relevant difference-makers for it; we grasp the conditions in which the phenomenon might have not occurred – or might have occurred in a different manner than it did. This grasp gives us a flexible, nuanced understanding of why the phenomenon explained occurs. Here is the distinction:

> Shallow knowledge is literal knowledge of an explanation. This may include the explicitly mentioned ideas in a text such as the definition of concepts, simple facts or properties of a concept or system, and even the major or large-scale steps in a

knowledge by testimony, surely the credit for knowing should belong to the witness giving the testimony, not to us as listeners, however much we might exercise open-mindedness or empathetic listening while we gain such knowledge.

[6] Child (2017) argues that there is a difference between saying the content of insights is creative and saying that the experience of insight itself is necessary for grasping that intuited content. It may be that we have reliable experiences of insight, but what is intuited in them would have occurred to us even if it lacked the striking, surprising conscious character it assumed. This is another way of challenging Lynch's idea that conscious insights typify the resulting understanding.

[7] We might, at the level of rote memorization, know *that* a given effect typically has a given cause.

> procedure. One can develop shallow knowledge with mere referential inference on the information given. This level of comprehension is at the semantically atomic level, where concepts lack inter-theoretic integration and there is a minimum of coherence achieved. Deep knowledge is, however, less straightforwardly defined. We know that it requires activating cognitive processes that enable the learner to build one form or another of cognitive representation of the situation being explained. Deep knowledge is achieved by the encoding into memory of detailed coherent explanations. This knowledge once achieved permits the subject to perform further inferences, solve problems, make decisions, make predictions, etc. (Newman 2012: 8)

For Newman, deep knowledge of an explanation follows from theoretical understanding; we can understand a phenomenon only if we understand the theory by which we explain it. He argues that *theoretical* understanding solves problems. We understand a theory, Newman thinks, only if we are able to put it to *use* in problem-solving: "[…] we take exams to show we have not only learned a theory by memorizing it – a shallow sort of knowing it – but also that we understand the theory; we know how to use it" (Newman 2017: 179).

It is not analytic that understanding a theory involves using it to solve problems. Rather, for Newman, the phases of theoretical understanding correspond to phases of problem-solving, so understanding is a species of problem-solving:

> [T]he parallel between their conceptual expertise model and our model of understanding of theory is obvious, and compelling. So in summary, according to van Lehn and van de Sande, what differentiates physics experts from novices is a complex group of cognitive abilities that stretch from advanced descriptive knowledge and rules for principle selection, to confluences based on qualitative interpretations of those principles and strategic planning on arriving at the correct solution. Let's call these the "understanding facts" (they seem to track nicely with our intuitions about theoretical understanding, and are derived from empirical studies):
>
> (1) description phase knowledge;
> (2) principle applicability knowledge;
> (3) principle confluences;
> (4) planning confluences.
>
> According to [the inferential model of understanding], these same stages are constitutive of expressing theoretical understanding. And if we are willing to accept that the two are co-extensive, we might quite happily endorse their unity. (Newman 2017: 591)

Here are two objections to Newman's line of thought. The relationship between understanding and problem-solving seems tenuous at best. Newman focuses on the cognitive science of solving problems in ele-

mentary physics. If, by contrast, one considers understandings of *historical* events, conjectures made about *physics* problems no longer apply. Techniques of measurement cease to apply when we deal with events that are – in the relevant sense – one of a kind. Due to singular causation, the counterfactual robustness typical of natural processes fails to apply. Historical events involve, first and foremost, intentions of the social actors at play.

For instance, take common partial explanations of why the stock market crashed in 1929. There is a background theory – Keynes' boom and bust view – that seeks to make sense of the market. Other considerations made by Keynes partly help to explain the event, such as renouncing the gold standard. These two explanations are related to some extent; because the gold standard was given up, differences between market value and real value could grow unhinged, and entrepreneurs are forced to become, to an increasing extent, speculators on the market. It is here that expectations about stocks – expectations about how buyers' expectations develop – become crucial, and "animal spirits" might trigger either boom or bust – or, typically, both in a cycle. All this has little if anything in common with how to solve physics problems.

Suppose, however, that we examine understanding in the formal and natural sciences alone. It follows from Newman's view that, if one finds oneself unable to solve problems one is faced with – especially when those problems are difficult, conceptual, or explanatory – then one does not truly understand. This is *regardless* of whether one has the right states of mind if one is unable to mobilize them in problem-solving activity. This consequence is, I think, implausible as long as it does not come as part of a *stipulation* concerning what counts as understanding.

4. Expertise

Are understanders experts at solving problems that involve what they understand? Catherine Elgin thinks so:

> [S]omeone who understands geometry can reason geometrically about new problems, apply geometrical insights in different areas, assess the limits of geometrical reasoning for the task at hand, and so forth. Understanding something like the Athenian victory is not exactly like understanding geometry, since the applications and extensions are more tentative, the range to which insights can reasonably be applied is more restricted, the evidence for a successful application is empirical (and may be hard to come by), and so on. But in both cases understanding involves an adeptness in using the information one has, not merely an appreciation that things are so. Evidently, in addition to grasping connections,

> an understander needs an ability to use the information at his disposal. (Elgin 2007: 35)

It is not that it simply so happens that understanding geometry involves solving geometry problems. Rather, one's understanding is commensurate to one's expertise (Newman 2017: 579). And one's expertise is assessed by one's capacity to solve non-trivial problems – so-called conceptual problems (Laudan 1977). In other words, one has the ability to anticipate qualitative solutions to problems that require detailed calculations and to qualitatively anticipate approximations of the results correctly. Here is an example:

> Consider the way Ludwig Boltzmann introduced the kinetic theory in his *Lectures on Gas Theory*. [He] devotes the introductory section to a purely qualitative analysis that leads to the conclusion that a gas can be pictured as a collection of freely moving molecules in a container. In a quite straightforward way, this molecular-kinetic picture can give us a qualitative feeling for the behaviour of macroscopic properties of gases. First of all, heat can be identified with molecular motion and it follows that an increase of temperature corresponds with an increase of the (average) kinetic energy of the gas molecules... Moreover, the picture immediately gives us a qualitative explanation of the fact that a gas exerts pressure on the walls of its container. If a gas molecule collides with a wall of the container, it gives it a little push. The total effect of the pushing of the molecules produces the pressure. In more formal terms: molecules exert forces on the wall and the total force of all molecules on a unit area equals the macroscopic pressure. (de Regt and Dieks 2005: 152)

One advantage of invoking expertise in support of the thought that understanding solves problems is that, according to it, there is not a disconnect between one's grasp of a theory and which theoretical virtues that theory enjoys. As de Regt explains:

> In this pragmatic dimension two elements play a crucial role: whether scientists are able to use a theory for explaining a phenomenon depends both on their skills and on the virtues of the theory. More precisely, it depends on whether the right combination of scientists' skills and theoretical virtues is realized. Particular virtues of theories, e.g., visualizability or simplicity, may be valued by scientists because they facilitate the use of the theory in constructing models and predicting or explaining phenomena; in this sense they are pragmatic virtues. But not all scientists value the same qualities: their preferences are related to their skills, acquired by training and experience, and to other contextual factors such as their background knowledge, metaphysical commitments, and the properties of already entrenched theories. (de Regt 2004: 103)

Here are two implausible consequences of this view. First notice that problem-solving is taken to be a reliable indicator of the skills understanders supposedly enjoy. Absent problem-solving, one would *still*

count as understanding; only the third-person evidence for *attributing* understanding would be missing.

Secondly, this account ties skill-*possession* with the *ability* to solve conceptual problems.[8] This might hold even *without* the manifestation of skill being required in solving the problems one has the ability to solve. From the fact that understanding is commensurate to one's expertise, it does not follow that moments of coming to understand – or of exercising a previously held understanding – need to solve concrete problems the thinker is facing there and then.

Conclusion

Often, we come to understand something by dispelling an initial sense of puzzlement. Granted, that does not always happen, but such subjective experiences raise a deeper question about the nature of understanding: do understanding and problem-solving relate in any deep metaphysical way? *Contra* widespread intuitions, I have argued that they do not. We cannot avail ourselves of a few successful cases in which scores of problems get solved following deep moments of understanding. There is a silent crowd of cases in which we understand without solving any palpable problem. We need to do justice to shiny and shadowy cases alike, so no general claim covering all can be properly supported.

It is natural to ask what the take-home lesson is from noting that problem-solving is *not* a necessary condition for understanding even if we considered several senses for "understanding" and "problem-solving" alike. The line of thought supported in the text suggests, by analogy, that such failures might occur on a larger scale. Consider thinking that reflective endorsement of how we conceive of things might be necessary for duly understanding them. Or consider thinking that it might be necessary, in order to properly understand something, that our understanding of it originates in the manifestation of intellectual virtues or cognitive skills. Assessing such claims will obviously depend on what we mean by "understanding," "reflective endorsement," "intellectual virtues," and "cognitive skills." It might also depend on which field of inquiry the necessary relationship envisaged is supposed to be relative to.

As in the case of understanding and problem-solving, it might be that such metaphysical claims of necessity cannot be adequately supported for the same general reasons highlighted here: differences in

[8] Set aside the thorny issue of trying to identify which problems get to count as conceptual.

the meanings of key words, and paying too much attention to famous cases at the expense of everyday ones (or the other way around). This article has worked as an example of how we might ascertain claims of metaphysically necessary conditions when it comes to genuinely understanding something. And the example suggests that we might best assess such claims semantically and evidentially rather than jumping to metaphysical conclusions.

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