

Understanding why, knowing why, and cognitive achievements

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Abstract:

Duncan Pritchard argues that a feature that sets understanding-why apart from knowledge-why is that whereas (I) understanding-why is a kind of cognitive achievement in a strong sense, (II) knowledge-why is not such a kind. I argue that (I) is false and that (II) is true. (I) is false because understanding-why featuring rudimentary explanations and understanding-why concerning very simple causal connections are not cognitive achievements in a strong sense. Knowledge-why is not a kind of cognitive achievement in a strong sense for the same reason knowledge-that is not. The latter thesis requires showing that having (p because q) information is not equivalent to having information about facts or principles that establish the explanatory connections between the phenomena in question. I make a positive case for this claim and defend it against objections. Based on this argument, I identify an alternative feature that sets understanding-why apart from knowledge-why: The minimal condition for understanding-why and knowledge-why with respect to their *contents* is not identical. Knowing why p merely requires information that some explanatorily relevant dependency obtains. Understanding why p additionally requires information about facts or principles that establish the explanatory connections between the phenomena in question.

Keywords: Understanding why | Knowing why | Cognitive achievement | Reductionism about understanding why | Causal explanation

Article:

1 Introduction

Is understanding why p simply knowing why p ? Duncan Pritchard argues that it is not.¹ According to him, understanding-why has two features that set it apart from knowledge-why. Unlike knowledge-why, understanding-why is compatible with environmental luck and it is a kind of cognitive achievement in a strong sense (short: CAS) (Pritchard 2008, 2010, 2014; Carter and Pritchard 2015). I am concerned with the second thesis which involves two claims:

(U-WHY = CAS) Understanding-why is a kind of CAS.
(K-WHY \neq CAS) Knowledge-why is not a kind of CAS.

Pritchard's arguments target knowledge-why and understanding-why in regard to *causal* matters. For the sake of simplicity, I follow this restriction. Moreover, his arguments are based on a thesis, which I do not question for the sake of argument:

(K-THAT \neq CAS) Knowing that p is not a kind of CAS.

One of Pritchard's argument for (K-THAT \neq CAS) is that knowledge-that can be acquired via testimony (more on that later). His argument for (K-WHY \neq CAS) is then straightforward: Knowing why p is commonly analyzed as a form of knowledge-that. Knowing why p is to know that (p because q), for some q .² Such knowledge can be also acquired via testimony. Thus, (K-WHY \neq CAS). Pritchard's argument for (U-WHY = CAS) is based on two assumptions: (i) Having a sound explanatory story regarding how cause and effect are related is a *necessary* requirement for understanding-why. (ii) Having (p because q) information is not equivalent to having such an explanatory story. He then argues that having an explanatory story regarding how cause and effect are related is a kind of CAS and that therefore (U-WHY = CAS).

These arguments can be questioned in at least two different ways. Grimm (2006, 2014), Kelp (2014), and Sliwa (2015) argue that coming to believe that (p because q) also requires having an explanatory story regarding how cause and effect are related. If they were right, Pritchard's argument for (K-WHY \neq CAS) would fail, according to his own criteria. If having an explanatory story regarding how cause and effect are related is a kind of CAS, then (K-WHY = CAS) and (U-WHY = CAS). Grimm (2012), Whiting (2012), and Carter and Gordon (2014) argue that having an explanatory story regarding how cause and effect are related is *not* a kind of CAS. If so, Pritchard's argument for (U-WHY = CAS) would fail. Then, it seems that (K-WHY \neq CAS) and (U-WHY \neq CAS). Either way, being a kind of CAS would not be a feature that sets understanding-why apart from knowledge-why. So, the crucial questions are: Does acquiring (p because q) information require having an explanatory story regarding how cause and effect are related? Is having an explanatory story regarding how cause and effect are related a kind of CAS?

In this paper, I argue that both questions should be answered in the negative. After introducing the concept of a CAS (Sect. 2) and after presenting Pritchard's argument for (K-WHY \neq CAS) in more detail (Sect. 3), I first elaborate on the explanatory story requirement (Sect. 4). Having a sound explanatory story regarding how cause and effect are related is to have information about facts or principles that establish the causal connections between the phenomena in question. Then, I make a positive case for the claim that coming to believe that (p because q), for some q , does *not* require having a sound explanatory story regarding how cause and effect are related, and I rebut Grimm's, Kelp's, and Sliwa's arguments against this claim (Sect. 5). (p because q) information is typically just information that some explanatorily relevant dependency obtains. So, if knowing why p is to know that (p because q) and if (K-THAT \neq CAS), then Pritchard is right that (K-WHY \neq CAS). Then, I argue that having a sound explanatory story regarding how cause and effect are related is *not* a kind of CAS (Sect. 6). Although the arguments given by Grimm, Whiting, Carter and Gordon can be rebutted, there is a clear-cut argument for this claim: One can

acquire at least some relevant explanatory stories via testimony. Hence, Pritchard's argument for (U-WHY = CAS) fails. The bottom line of my paper is thus that being a kind of cognitive achievement in a strong sense does *not* set understanding-why apart from knowledge-why. It seems that (K-WHY \neq CAS) and (U-WHY \neq CAS). However, if knowing why p is to know that (p because q), for some q , we have identified an alternative feature that sets understanding-why apart from knowledge-why: The minimal condition for understanding-why and knowledge-why with respect to their *contents* is not identical. Knowing why p merely requires information that some explanatorily relevant dependency obtains. Understanding why p additionally requires information about facts or principles that establish the explanatory connections between the phenomena in question.

2 Cognitive achievements

Reaching the top of Ben Nevis on foot is a paradigmatic case of an achievement. However, defining the notion *achievement* or *cognitive achievement* has proven to be a demanding endeavor. Here, I don't discuss its challenges (see, e.g., Turri 2011; Greco 2012; Carter et al. 2015; Navarro 2015). Instead, I introduce an account along Pritchard's lines.

The term 'cognitive' shall include all mental processes, such as reasoning, processing stimuli, and memorizing. Cognitive achievements are cognitive *successes*. Pritchard equates cognitive successes with true beliefs (Pritchard 2014, p. 319). This is too narrow a conception. Counting flawlessly to 1000 and mental simulations are also cognitive successes. But for the question at hand a narrow conception suffices because, arguably, success in the case of knowing why p and understanding why p is to have *true* beliefs as to why p . A success is a particular *outcome* of an activity, namely its realized aim (broadly understood). The term 'aim (broadly understood)' shall include directed activities that do not involve a goal in the narrow sense, for instance, instinctive activities or *en passant* activities, such as processing the colors of items *en passant*. The outcome must stand in a particular relation to the activity to count as an achievement: *First*, the activity must contribute to realizing the outcome roughly as intended. For instance, when I start raising my arm someone else cannot finish lifting it, if the raised arm is supposed to be my achievement. *Second*, the activity must not be done in a random way, but it should be an exercise of a relevant *ability* (Pritchard 2014, p. 318). For instance, if someone hits the bull's eye by randomly using a bow we would hesitate to call this an achievement. *Third*, the activity must be the decisive factor for accomplishing the outcome. Just being *a* decisive factor would not be enough. Many factors contribute to realizing an outcome, such as the materials used. What the decisive factor amounts to is not observer-independent, as Greco (2012) emphasizes. What we consider decisive are often the salient or unusual things. Defining the notion of the decisive factor in more detail has proven to be challenging (for proposals see, e.g., Turri 2011; Greco 2012). For our purposes, a rough outline suffices: Successes are excluded that involve so-called *intervening luck*. The peculiarity of such luck is that it intervenes in the causal chain of the process. One example is an archer who successfully hits a bull's eye because there was a lucky gust of wind. Had the lucky gust not been there, the archer wouldn't have been successful (Pritchard 2010, p. 28). Any change in the wind conditions would have led to a failure. Here, the agent's activity is not the decisive factor, but the gust is. So, a *counterfactual* evaluation might be apt for determining whether an activity is the decisive factor for realizing the outcome: one examines situations where the conditions are slightly varied while the activity is held fixed. If there would be no difference in the outcome, the

activity was the decisive factor. If there would be a difference, it was not. The outcome should be described in an *agent relative way*, such as the *archer's* hitting the bull's eye.

We arrived at the following definition:

COGNITIVE ACHIEVEMENT: The outcome of someone's cognitive activity is a cognitive achievement iff (1) it is an accomplishment of the activity's aim (broadly speaking), (2) it is a true belief, (3) the cognitive activity is an exercise of an ability relevant to accomplishing the outcome, and (4) the cognitive activity is the decisive factor for accomplishing the outcome.

Pritchard argues that this definition is too inclusive to capture our ordinary notion of an achievement (Pritchard 2010, p. 68). Typically, achievements are *praiseworthy*. Successes resulting from *en passant* activities or easy successes, such as acquiring simple perceptual beliefs in good visual conditions, are typically not considered praiseworthy because of their ease; but this definition would not exclude them. Pritchard suggests that achievements in a strong sense can be accomplished in two ways (Pritchard 2010, p. 68): The success is gained by *overcoming a significant obstacle* to the relevant success, such as acquiring a true visual belief in low lighting, or the lack of difficulty is the *result of training*. An example is Sherlock Holmes's rather effortless processing of his environment with respect to clues (Pritchard 2010, p. 72). In general, someone who exercises a *significant level of ability* achieves something even when the exercise is performed with ease. This gives us the following definition:

COGNITIVE ACHIEVEMENT IN A STRONG SENSE (CAS): The outcome of someone's cognitive activity is a cognitive achievement iff (1) it is an accomplishment of the activity's aim (broadly speaking), (2) it is a true belief, (3) the cognitive activity is an exercise of an ability relevant to accomplishing the outcome, (4) the cognitive activity is the decisive factor for accomplishing the outcome, and (5) the cognitive activity involves the application of a significant level of ability or³ the overcoming of a significant obstacle to the relevant success.

As we have seen, intervening luck is incompatible with achievements. Pritchard claims, though, that achievements are compatible with so-called *environmental* luck. A paradigmatic case of such luck is Goldman's barn-case (Goldman 1976): A man enters a country full of fake barns which all look like barns—unbeknownst to himself. If he then identifies a real barn as a barn, this seems to be mere luck. He could have easily classified a fake barn as a barn. His luck is environmental because it relates to the environment and is not due to an *intervention* in the exercise of his cognitive ability; his vision works fine. Pritchard claims that such luck is compatible with achievements precisely because nothing intervenes in the activity (Pritchard 2014, pp. 318–319). I don't question this claim here.

3 Thesis: knowledge-why is not a kind of CAS

Pritchard argues that knowing *that p* is not a kind of CAS (Pritchard 2010, 2012, 2014): (κ -THAT \neq CAS). Here, I do not evaluate his arguments, but I briefly introduce them. His *first* argument is concerned with *testimony*. Following Lackey (2007), Pritchard classifies ordinary

cases of knowledge acquisition via testimony from a reliable and knowledgeable source as cases where the success of acquiring a true belief is *not* primarily creditable to the agent. Assume that Tina acquired the true belief that Julien has the hiccups via a reliable and knowledgeable source. Gaining this true belief is not primarily creditable to Tina. She must understand some sentences to acquire the belief, but that she ended up with having a true rather than a false belief is not primarily due to correctly understanding those sentences; it is because her informant was knowledgeable. Tina's cognitive activity is thus not the decisive factor for accomplishing the outcome. Nonetheless, she gained knowledge. Pritchard's *second* argument is that knowledge-that is not compatible with environmental luck. For instance, coming to believe that there is a barn by seeing a real barn does not amount to knowing that there is a barn, due to the luck involved. By contrast, cognitive achievements are compatible with such luck.

Pritchard's arguments for the claim that knowledge-why is not a kind of CAS do not go further than his arguments for (K-THAT \neq CAS). The reason is simple: Knowing why p is commonly analyzed as a form of knowledge-that. The content of knowing why p is analyzed in terms of true answers to the question 'Why p ?'.⁴ Answers to why-questions are typically said to be specific complex propositions of the form (X is the case because of Y) or (p because q), for some q (see, e.g., Grimm 2006, 2014; Pritchard 2008, 2014; Kelp 2014; Sliwa 2015; Riaz 2015; Hills 2016). Take Pritchard's illustration (Pritchard 2008, p. 332): "[...] to know why my house burned down is just to know that it burned down because of (say) faulty wiring." One can know why p by knowing different contents. Compare 'Tom knows that (Julien has the hiccups because he ate his lunch quickly)' and 'Tina knows that (Julien has the hiccups because a reflex of his diaphragm was stimulated).' Both know why Julien has the hiccups, but the content of their knowledge-why differs. In other words, there can be more than one correct answer as to why p . Assuming that ' X is the case because of Y ' is interchangeable with ' p because q ,' this gives us the following analysis:

K-WHY (COMMON ANALYSIS): S knows why p iff for some q , S knows that (p because q).

Since (p because q) propositions are just complex propositions, (p because q) knowledge is a form of knowledge-that. It can be acquired via testimony and is not immune to environmental luck. If so, (K-WHY \neq CAS).

One possibility to rebut (K-WHY \neq CAS) is to argue that (K-THAT \neq CAS) is false (for an attempt that is concerned with knowledge-why see, e.g., Kelp 2014).⁵ However, I take (K-THAT \neq CAS) for granted here. Another possibility is to argue that K-WHY (COMMON ANALYSIS) is false. But, to my knowledge, this objection has not been advocated.⁶ It seems plausible that knowing why p is to know that (p because q), for some q .⁷ If so, the only option left is to argue that (p because q) knowledge is a kind of CAS. This option becomes available when one considers in more detail what is required for (p because q) knowledge. It is precisely this matter that turns out to be crucial for evaluating (K-WHY \neq CAS) and (U-WHY = CAS), as I show in what follows.

4 The explanatory story requirement

Pritchard claims that understanding-why requires the following (Pritchard 2014, pp. 322–323):

[...] [I]n representing oneself as being in possession of an understanding of some event, no matter how limited, one is representing oneself as not merely being able to identify the cause of that event, but also as being able to offer a sound explanatory story regarding how cause and effect are related.

The thesis that one must have a sound explanatory story for understanding-why is rather uncontroversial. I do not question it here. Instead, I am concerned with the distinction between identifying the cause and having an explanatory story. This distinction is crucial for Pritchard's arguments. He argues that having such an explanatory story is a kind of CAS, but that it is not required for (*p* because *q*) knowledge and thus not for knowledge-why. Grimm (2014), Kelp (2014), and Sliwa (2015) argue that having such an explanatory story is required for acquiring (*p* because *q*) knowledge. For evaluating these claims, it is important to elaborate on the explanatory story requirement. Pritchard does not go into detail. But I give a more precise account in this section.

First of all, it is important to acknowledge that what we consider to be *the* cause is partially a context-dependent or subject-dependent matter, as Lewis famously claims (Lewis 1986, p. 162):

The multiplicity of causes [...] are obscured when we speak [...] of *the* cause of something. [...] If someone says that the bald tire was the cause of the crash, another says that the driver's drunkenness was the cause, and still another says that the cause was the bad upbringing which made him so reckless, I do not think any of them disagree with me when I say that the causal history includes all three. They disagree only about which part of the causal history is most salient for the purposes of some particular inquiry.

In one context, Julien eating his lunch quickly is *the* cause of his hiccups and in another one, it is the stimulation of his diaphragm.⁸ However, discussing the context-sensitivity of causal claims is not crucial here. In what follows, 'the cause' refers to some relevant causal factor.

So, let us turn to the difference between identifying the cause of a phenomenon and having an explanatory story. Identifying the cause of a phenomenon is identifying some relevant causal factor. To state that some phenomenon is the cause of another phenomenon is typically understood as stating that the latter is causally *dependent* on the former. For instance, by stating that a stimulation of his diaphragm was the cause for Julien's hiccups one states that the hiccups were causally dependent on the stimulation. The nature of causation is a controversial issue. However, it is typically assumed that causal dependencies are *asymmetric*; if *Y* is the cause of *X*, *X* is not the cause of *Y*. So, knowing that some phenomenon is the cause of another phenomenon comes with some information about the relation between cause and effect. But importantly, such information is just *general* information about phenomena in a causal relation. Having an explanatory story regarding how cause and effect are related goes beyond having general information about causality. Instead, such an explanatory story is tailored to the causal connections between the particular phenomena in question. As some decades of debates have shown, the precise nature of causal explanations is difficult to capture and there is no broad consensus on the horizon. However, for our purposes, we can abstract away from the differences between the various accounts of causal explanation. Skow introduces a helpful notion to characterize the essence of explanatory stories regarding how cause and effect are related,

namely the notion of a so-called *vertical follow-up question*. Such a question is concerned with the connection between cause and effect. (Skow 2016, pp. 79–80):

[We are] asking what the facts in the [causal] chain have done to belong in the chain. [...] Why did she [throw a rock]? Because Billy has been ignoring her again. What does that have to do with it?

The ‘What does that have to do with it?’ question is vertical because it is concerned with the causal *connections* between the effect and its cause.⁹ Another example Skow uses is the statement ‘The rock hit the ground at a speed of 4.4 m/s because it was dropped from a height of one meter’ (cf. Skow 2016, p. 75). Here, the follow-up question is ‘What does the fact that the rock was dropped from a height of one meter have to do with the rock hitting the ground at a speed of 4.4 m/s?’ What is relevant for our initial question is that answers to the how-question ‘How are cause and effect related?’ are also answers to the vertical follow-up question. For instance, a description of the process that led from Billy’s ignoring Suzy to her throwing the rock is both an answer to the question ‘How are Billy’s ignoring Suzy and her throwing the rock related?’ as well as to the question ‘What does the fact that Billy has been ignoring Suzy have to do with her throwing the rock?’.¹⁰

I thus suggest that the essence of an explanatory story regarding how cause and effect are related is an answer to the vertical follow-up question. The essence of an *answer* to such a question can also be characterized irrespective of a particular account of causal explanation. It can be characterized as describing *facts or principles that establish the causal connections between the effect and the cause in question*. Taking a pluralist stance on causal explanations, these can be, say, a description of the *causal process* that led from the cause to the effect, a description of the *causal mechanism* that produces the effect, or an application of a *causal law*. For instance, an answer to the vertical follow-up question regarding the impact speed of 4.4 m/s could consist of pointing out that it is in accordance with a law of gravitation that dropping a rock from a height of one meter results in a speed of 4.4 m/s (cf. Skow 2016, p. 75). Since descriptions of causal processes or mechanisms can be more or less detailed, there could be more than one sound explanatory story.

To sum up, identifying the cause is identifying the relevant causal factor. Having an explanatory story regarding how cause and effect are related is to have information about facts or principles that establish the causal (or, more generally, explanatory) connection between the phenomena in question.¹¹ Pritchard claims that having such an explanatory story is not required for knowledge-why. This has been contested. So, let us turn to this matter.

5 Knowledge-why and the explanatory story requirement

Given K-WHY (COMMON ANALYSIS), the relevant question is whether acquiring (*p* because *q*) information requires having an explanatory story regarding how cause and effect are related. Pritchard does not argue in detail why we should answer this question in the negative. In what follows, I first make a case for this claim, then I address Grimm’s, Kelp’s, and Sliwa’s objections, and I discuss consequences for an account of knowledge-why. Ultimately, (K-WHY \neq CAS).

5.1 The positive case

One example Pritchard uses to motivate the claim that knowledge-why does not require having an explanatory story regarding how cause and effect are related is as follows (Pritchard 2014, p. 316):

Kate comes to know that it was the introduction of the oxygen which caused the chemical reaction not because she figured this out for herself, but because a fellow scientist, who has specialised expertise in this regard which our hero lacks, informs her that this is the cause of the reaction. [...] Kate, while generally proficient in chemistry, does not have any sound epistemic grip on why the introduction of oxygen should have this effect on the substances in question.

Kate knows that the cause of the chemical reaction is the introduction of oxygen, but she does not know how they are related.¹² She could not answer the question ‘What does the fact that oxygen has been introduced have to do with the occurrence of the chemical reaction?’ Another prominent example Pritchard introduced is a scenario where a child learns via testimony from a fire officer that his or her house burned down because of faulty wiring, but not how the faulty wiring led to the house burning down (Pritchard 2008, p. 332). Grimm also provides us with a similar example: a car mechanic tells her customer that the cause of the gauges’ death is a bad ignition switch in her car, but not how the bad ignition switch led to the gauges’ failure (Grimm 2006, p. 531). The crucial point is that the respective subjects nonetheless seem to acquire (*p* because *q*) knowledge. Kate seems to know that (the chemical reaction occurred because oxygen had been introduced). The child seems to know that (the house burned down because there was faulty wiring). The car customer seems to know that (the gauges failed because there is a bad ignition switch). We can generate many similar cases. In addition, I suggest that there are similar cases that do not involve testimony. Imagine that a scientist applies reliable techniques to determine what a (or the) decisive causal factor for a chemical reaction is. Assume that her confident conclusion is that the introduction of oxygen was the decisive factor. Nonetheless, the scientist might still lack information about facts or principles that establish the causal connection between these phenomena. She might merely have some hypotheses. Importantly, to learn about a crucial part of a causal process before discovering other parts is common in science.

The examples suggest that acquiring (*p* because *q*) information can come apart from having information about facts or principles that establish the explanatory connections between them. One can correctly believe that (the house burned down because there was faulty wiring) without ascertaining what facts or principles establish the connection between the faulty firing and the burnt-down house. This is in line with the fact that we typically employ (*p* because *q*) or (*X* is the case because of *Y*) propositions to just name the relevant causal factor, such as ‘The car accident happened because there were poor road conditions’ or ‘The car accident happened because of the poor road conditions.’ Such a claim just states that some relevant causal dependency between the *p*-phenomenon and the *q*-phenomenon obtains. Since ‘because’ is also used for non-causal explanations, I follow proposals by Kim (1994), Greco (2014), and Grimm (2014) and speak of an *explanatorily relevant dependency*.

Knowing *that* something is the case can come apart from knowing *by virtue of what facts or principles* it is the case. But this is not a peculiarity of (*p* because *q*) knowledge. Take different knowledge-that cases: scientists can discover that some non-accidental generalization holds without knowing which facts or other generalizations it holds because of. One can know that Obama was elected to be the forty-fourth president of the US without knowing that this was due to the fact that he won 365 electoral votes, while his opponent received only 173. Likewise, one can know that faulty wiring was a causal factor for the house burning down without knowing by virtue of which facts or principles the faulty wiring caused the house to burn down.

One might worry that this is too broad a conception of (*p* because *q*) information. What if one had a false belief about the relation between cause and effect? What if Suzy were to believe that the faulty wiring caused a fire in the living room although it caused one in the kitchen? Does Suzy nonetheless know that (the house burned down because there was faulty wiring)? That depends. If Suzy would understand the faulty wiring to be connected to wires in the living room, then she does not. In this case, Suzy would have a false belief about what the faulty wiring in question is. The *q* in her (*p* because *q*) proposition would then be false. But let us suppose that Suzy believes that there was faulty wiring somewhere in the house, and she knows that faulty wiring could lead to fire in several ways. In this case, the false belief that the faulty wiring caused a fire in the living room does not seem to undermine her knowledge that (the house burned down because there was faulty wiring). Suzy is simply mistaken about *how* the faulty wiring led to the result. Similarly, a scientist can be mistaken about the details of the causal process of a chemical reaction and yet know that the introduction of oxygen caused it. Or one can know that Obama was elected to be the forty-fourth president despite falsely believing that this is because he won 400 electoral votes.

Last but not least, what I am arguing is not that (*p* because *q*) information cannot contain an answer to *some* vertical follow-up question. Imagine that Suzy knows that (the house burned down because there was faulty wiring, which caused sparks that set the wooden walls of the house on fire, and nobody combated the flames). So, there are (*p* because *q*) constructions that merely express that some explanatorily relevant dependency obtains, and (*p* because *q*) constructions that also contain an answer to some vertical follow-up question. However, the crucial point is that not every (*p* because *q*) construction contains such an answer.

5.2 Objections

I have just argued that acquiring (*p* because *q*) information does *not* require having an explanatory story regarding how cause and effect are related. Why might one doubt this? According to Grimm, it “[...] is not clear [that the subject] understands the content [that his house burned down because of the faulty wiring] well enough to actually believe it” (Grimm 2014, p. 332; similarly Sliwa 2015). One needs to grasp the relation between cause and effect at least somewhat in order to grasp a (*p* because *q*) proposition (Grimm 2014, p. 338). Kelp endorses Grimm’s arguments (Kelp 2014, p. 349). Let us turn to the details.

Sliwa is concerned with the fire scenario. She argues that “[i]n so far as it’s plausible to attribute to the child the knowledge that the house burned down because of faulty wiring, we do attribute

some degree of understanding of why [...]” (Sliwa 2015, p. 70). So, knowing that (the house burned down because there was faulty wiring) comes at least with having some rudimentary story regarding how cause and effect are related. She further argues that when one makes the case that the child does not have any understanding-why, it seems clear that he or she also does not know that (the house burned down because there was faulty wiring) (Sliwa 2015, p. 70, italics omitted):

Thus, suppose that the child truly hasn’t the faintest clue what faulty wiring could possibly be—from the child’s perspective the house burning down because of faulty wiring is compatible with its being struck by lightning, its being set on fire by someone, and its spontaneously erupting into flames. In this case, [...] the child does not [...] know that the house burned down because of faulty wiring. (He may, of course, know that it was something that the grown-ups call ‘faulty wiring’ that caused the fire—whatever that is.)

This suggests that Sliwa’s objection is that having *conceptually false* ideas about how faulty wiring could lead to a house burning down prevents someone from knowing that (the house burned down because of faulty wiring). This sounds plausible to me. However, this objection is beside the point for two reasons (cf. Lawler 2016): *First*, arguably, knowing that (*p* because *q*) requires understanding what the terms involved mean. There are surely differences in understanding a term. But being able to at least roughly characterize what the terms involved mean is a minimal requirement for knowledge acquisition. To think that faulty wiring singled out as the causally essential factor is compatible with the house being struck by lightning, its being set on fire, or its spontaneously erupting into flames seems to be a case of not understanding what faulty wiring is. However, this is *not* the assumption in Pritchard’s fire scenario. It is assumed that the child knows at least roughly what faulty wiring is. The point of the fire scenario is that faulty wiring could lead to a fire in several ways and that merely knowing that faulty wiring was causally decisive does not amount to knowing which of these ways was realized in the particular case. *Second*, as Pritchard clarifies (Pritchard 2014, p. 321), it is not assumed that the subjects have no clue whatsoever about the relation between cause and effect. The subjects might well *hypothesize* how the cause might have caused the effect. The crucial point is that the subjects do not have “[...] a sufficient explanatory grip on how this particular cause generated this particular effect” (Pritchard 2014, p. 322). They could not answer the vertical follow-up question.

But what about Grimm’s objection? In his 2006 paper, Grimm introduced the car mechanic case I mentioned early. Here, the subject learns that the gauges’ failure is due to a bad ignition switch, but “[...] fails to grasp how a bad ignition switch might lead to this result” (Grimm 2014, p. 531). In the main text, Grimm does not question that (*p* because *q*) knowledge is gained. However, in a footnote he explains why he believes that this is not the case (Grimm 2014, footnote 21, pp. 531–532):

[...] [I]n order to assent to a dependency claim along the lines of A because of B in a way that really amounts to assent (as opposed to just a mouthing of the words “A because of B”), one must possess [...] [a] sort of counterfactual manipulative ability [...].

He analyzes the required sort of *counterfactual manipulative ability* along Woodwardian lines (Grimm 2006, p. 532)

[...] in terms of having an ability to answer “what-if-things-had-been-different?” questions. To have an ability to answer questions of this sort [...] is to be able to anticipate the sort of change that would result in the thing we want to explain [...] if the factors cited as explanatory [...] were different in various ways.

An answer to a what-if-things-had-been-different question seems to be an answer to a vertical follow-up question. One establishes the causal connection via examining counterfactual situations. In a later paper, Grimm specifies a minimal requirement for such answers (Grimm 2014, p. 338):

[...] it is hard – perhaps impossible – to genuinely assent to [a (*p* because *q*) proposition] without in some way grasping that what it means for these two items to stand in the ‘because’ relation is that a change in the state of the former will lead to a change in the state of the later [sic] (*ceteris paribus*).

So, his claim is that to know that (*p* because *q*) one must have at least some grip on how the *q*-phenomenon and the *p*-phenomenon are related: one has to know that if the former had been different, the latter would have been different. One has to know that “[...] if the wires had not been faulty—then the house would not have burned down (*ceteris paribus*)” (Grimm 2014, p. 337). Without such knowledge, a subject does not assent “[...] to the proposition that [the] house burned down because of the faulty wiring but rather a “nearby” proposition, such as that whatever the fire chief just said is true [...]” (Grimm 2014, p. 338).

Importantly, Grimm seems to be articulating different objections: One concerns a *general* causal belief that a change in the *q*-phenomenon will lead to *some* change in the *p*-phenomenon. This belief is not tailored to any particular phenomenon. The other one concerns the anticipation of the *sorts* of counterfactual changes that would affect the *p*-phenomenon if specific aspects of the *q*-phenomenon were changed. This is tailored to the particular phenomena. Let me start with the first objection. It is akin to Sliwa’s worry insofar as it questions whether subjects in cases like the fire scenario properly *understand* the (*p* because *q*) proposition. If a counterfactual dependency is part of the nature of causal dependency, perhaps one must grasp the former to understand a (*p* because *q*) claim. My issue with Grimm’s objection is twofold: *First*, it is beside the point. Pritchard’s scenarios assume neither that the subjects do not understand *in general* what a causal dependency is nor that the subjects lack any hypothesis about what would happen if the *q*-phenomenon did not occur. The child might well hypothesize that the house would not have burned down if there had not been faulty wiring. But this would not change the cases. The child would nonetheless lack information about how the faulty wiring led to the house burning down. To put the point differently, it is not an answer to vertical follow-up question, but merely *general* information about causal dependencies, that (the *p*-phenomenon would not have occurred if the *q*-phenomenon had not occurred (*ceteris paribus*)). *Second*, Grimm disregards the challenge to his claim posed by cases of causal overdetermination or preemption (see, e.g., Schaffer 2003). In such cases, it is not true that the *p*-phenomenon would not have occurred if the *q*-phenomenon had not occurred (*ceteris paribus*). Cases of causal *preemption* are cases with

a causal back-up. If A had not caused B, A'' would have. Cases of causal *overdetermination* occur when an effect is due to multiple causes that each alone would account for the effect. If Anne and Bob shoot Carl at the same time and either shot alone would have been lethal, Carl's death is causally overdetermined. If Anne shot him but Bob would have done so otherwise, it is a case of causal preemption. The crucial question is whether the claim (Carl died because Anne shot him) is true in cases of preemption or overdetermination. I am strongly inclined to think that it is. Anne's shot is a causally decisive factor for Carl's death in both cases. If so, it is *not* the case that (*p* because *q*) information comes with information that (the *p*-phenomenon would not have occurred if the *q*-phenomenon had not occurred (*ceteris paribus*)).

The second point is also relevant for Grimm's *second* objection, which is the objection that one must be able to anticipate specific counterfactual changes for acquiring (*p* because *q*) information. If (*p* because *q*) propositions are compatible with overdetermination or preemption, such an ability could not be *necessary* for acquiring (*p* because *q*) information. Even when we put these unusual cases aside, the first objection does not look promising. Such a requirement seems clearly too demanding. Imagine that a causal process is so complex that it is difficult to know how the changes in some value lead or might fail to lead to changes in others (this example is inspired by Strevens 2016). Think of the 2007–2008 financial crisis. It seems clear that it happened (*inter alia*) because of the bursting of a housing bubble in the United States. However, our financial market is so complex that laymen typically do not have any counterfactual manipulative knowledge regarding the crisis. Even experts can lack such manipulative knowledge. Nonetheless, it seems to be true that both laymen and experts know that (the financial crisis occurred because the housing bubble burst). If so, being able to anticipate specific counterfactual changes is not necessary for acquiring (*p* because *q*) information.

5.3 Consequences for an account of knowledge-why

Let us take stock. I have argued that (*p* because *q*) information does not amount to having an explanatory story regarding how cause and effect are related. (*p* because *q*) information is typically just information *that* some explanatorily relevant dependency between the *p*-phenomenon and the *q*-phenomenon obtains. Acquiring a (*p* because *q*) belief requires having a general conception about causal dependencies. However, it would not threaten Pritchard's arguments for (K-WHY ≠ CAS) if we required such general beliefs. Understanding what the connectives in a sentence mean (here 'because') is required for *any* belief acquisition. So, that a subject ends up with having a true rather than a false (*p* because *q*) belief in a testimony case is no more or less a cognitive achievement than in other cases of belief acquisition. So, if (K-THAT ≠ CAS), then (K-WHY ≠ CAS).

In light of this discussion, one might question the common analysis of knowledge-why. Acquiring only knowledge that some explanatorily relevant dependency obtains might not be enough for acquiring knowledge-why. My worry is that such a conception of knowledge-why is too demanding to do justice to ordinary contexts. It would be odd to say that one knows the cause of an effect, but does not know why the effect occurred. Consider the statement 'I know that (the house burned down because there was faulty wiring), but I do not know why it burned down,' or 'Maria knows that (her grandfather died because he had stomach cancer), but she does not know why he died.' Perhaps one could explain away the oddness of such statements or make

a strong case for giving up the common analysis. However, I do not pursue this radical strategy here. Instead, I suggest an alternative for accommodating the impression that the knowledge-why that subjects like Kate, the child, or the customer gain is *shallow*, so to speak. Let us employ the concept of an explanatory story to identify two interesting variants of knowing why p :

SHALLOW KNOWLEDGE-WHY: S has shallow knowledge why p iff for some q , (i) S knows that (p because q), but (ii) S lacks any relevant true belief about what establishes the explanatory connections between cause and effect.

NON-SHALLOW KNOWLEDGE-WHY: S has non-shallow knowledge-why p iff for some q , (i) S knows that (p because q), and (ii) S knows what establishes the explanatory connections between cause and effect.

Everyone who knows that (p because q), for some q , has knowledge-why. The notions of shallow and non-shallow knowledge-why are not meant to exhaust cases of knowledge-why. But they are by definition mutually exclusive because shallow knowledge-why demands lacking particular pieces of information. When philosophers of science speak about knowledge-why, they typically mean non-shallow knowledge-why. Paradigmatic scientific explanations tell us an explanatory story about the phenomena in question. Moreover, we would expect *experts* about a phenomenon to have non-shallow knowledge-why. Yet, shallow knowledge-why often suffices for the needs of everyday life.

Given these concepts, a new thesis concerning CAS and the relation between knowledge-why and understanding-why arises. If Pritchard were right that having an explanatory story regarding how cause and effect is related is a kind of CAS, then (u-why = cas) and (K-WHY (NON-SHALLOW)) = CAS). This does not render (K-WHY \neq CAS) false, but it would be relevant for further exploring the relation between knowledge-why and understanding-why.¹³ So, let us turn to the question whether having such an explanatory story is a kind of CAS.

6 Understanding-why and the explanatory story requirement

Pritchard considers understanding-why to be a kind of CAS because having an explanatory story is such a kind. After presenting his argument, I discuss objections against it. I argue that most of them don't succeed, but that they point to two kinds of counter-examples. Thus, (U-WHY \neq CAS).

6.1 Pritchard's argument

Recall that Pritchard considers having a sound explanatory story regarding how cause and effect are related to be *necessary* for understanding-why. In other words, he demands answers to the vertical follow-up question for understanding-why. Recall further that there is typically not just one possible answer to this question. Pritchard accommodates this fact by claiming that "[...] understanding comes in degrees" (Pritchard 2014, p. 323). Writing about why one's eyes water when chopping onions, he claims that "[...] one could imagine someone having a rudimentary grasp of how chopping onions can cause one's eyes to water which suffices for a *limited* kind of understanding of the target event [...]" (Pritchard 2014, p. 323, my italics). So, while an answer to the follow-up question is necessary, a *rudimentary* answer suffices for limited understanding-why. Understanding-why is supposed to involve the exercise of a significant level of ability or

the overcoming of a significant obstacle because having an explanatory story involves the latter (Pritchard 2010, pp. 82–83, my italics):

Typically, [...] one gains understanding by undertaking an obstacle-overcoming effort to piece together the relevant pieces of information. Moreover, where understanding is gained with ease, this will be because of the fact that one is bringing to bear significant cognitive ability. Perhaps, for example, in coming across one's house in flames one is immediately able to gain an understanding of why this event is occurring because one is able to observe some crucial feature of the event taking place before one which—along, say, with the relevant background information that one possesses—definitively indicates *how this event came about in such a way* as to afford one the relevant understanding. But here the spontaneity of the understanding is entirely due to the exercise of significant cognitive ability [...].

It seems plausible that having an explanatory story regarding how cause and effect are related requires putting together the relevant pieces of information. Having an explanatory story does not amount to believing *any* bunch of propositions; they have to be *interrelated* propositions. Imagine someone who knows several propositions describing the causal process at hand, but doesn't know how they are related. This person does not have an explanatory story until she pieces the propositions together in the correct way. Pritchard's claim is that when the piecing together comes with ease it is because of the application of a significant level of ability and when it does not come with ease it involves overcoming a significant obstacle. For instance, a chemist can put together an explanatory story for a chemical reaction with less effort than a pupil. Having an explanatory story, and thus understanding-why, count as cognitive achievements due to this indispensable exercise of the agent's cognitive ability. The piecing together cannot be achieved solely via testimony; it "[...] is not the kind of epistemic standing that one can acquire by for the most part trusting the word of another (no matter how authoritative one's informant is)" (Pritchard 2014, p. 320). So, in the case of having an explanatory story, all requirements for a CAS seem to be fulfilled: The outcome of the piecing together is an accomplishment of the activity's aim, it is a true belief, and the cognitive activity, i.e., the piecing together of information, is an exercise of a relevant ability, is the decisive factor for the outcome, and it involves the application of a significant level of ability or the overcoming of a significant obstacle.

It is because of the indispensable exercise that Pritchard further claims that understanding-why is compatible with environmental luck. One can gain understanding-why in environmental luck situations because "[...] the cognitive success, while lucky, is [...] primarily creditable to the cognitive agency of the subject" (Pritchard 2014, p. 319). So, in the country full of fake barns it is possible to gain understanding-why, although not knowledge.

6.2 Objections

Carter and Gordon raise two objections to the claim that having an explanatory story and thus understanding-why is a CAS (Carter and Gordon 2014): (1) Piecing together the relevant information does not always involve a similar level of difficulty. (2) In some cases, merely *average* abilities or average effort is required. Their *first* argument features a case of what they

dub *easy understanding* (Carter and Gordon 2014, p. 5): Someone understands why the tumble-dryer stopped working by noticing that it was unplugged. There is not a significant obstacle because “[...] one can work out quite easily why the tumble-dryer stopped working” (*ibid.*). They contrast this case with a case where someone understands a complex theory and conclude: “[...] clearly the piecing together of information required for understanding-why does not always involve the same (or even a similar) kind of obstacle [...]” (*ibid.*). This is supposed to be a problem for Pritchard for the following reason (*ibid.*):

The grounds for [his] view look shaky if it turns out that the piecing together of information required for understanding-why does not always involve a similar level of difficulty. After all, if it doesn't, then there's little motivation for the position that there is some level of difficulty involved in the piecing together of information required for understanding-why that can't be overcome easily except by one with significant skill.

This objection is unconvincing: *First*, it is unproblematic that piecing together information can involve *dissimilar* obstacles. CAS is a *threshold* concept; it only matters that there is *some* significant obstacle. *Second*, Pritchard does not demand a significant skill but the exercise of a significant level of ability. These are crucially different requirements. Arguably, a significant skill is a remarkable skill. By contrast, even *ordinary* abilities can have a significant level. Consider the ability of carrying furniture. This is not a remarkable skill, but there are different levels to the ability. Someone who carries furniture for the first time typically does not have a significant level of the ability. Experienced furniture movers typically do. If they exercise their ability with ease, they achieve something by carrying furniture. One might object that having a significant level of ability is just a different expression for having a *skill*. For instance, it seems apt to say that experienced furniture movers—but not first-time movers—have a *skill* of carrying furniture. However, if this were correct, this would not threaten my point. There would still be a difference between a *significant* skill and a skill. Then, my objection would be that Pritchard's account only demands a skill but not a significant one.

Third, it is implausible that no significant obstacle is involved in Carter and Gordon's case. Discovering that the dryer was unplugged only provides someone with an understanding-why the tumble-dryer stopped working if she can answer the vertical follow-up question. In order to do that one must apply one's knowledge about how dryers, outlets, cables, and electricity are connected. This application of knowledge seems so ordinary that we typically don't mention it. But it must nonetheless be applied. So, there is a significant obstacle involved. When the overcoming comes with ease, one applies a significant level of ability. Compare someone who learns for the first time how dryers work with someone who knows a lot about them.

Carter and Gordon's second argument features a case of what they dub *shallow understanding*. They imagine a novice fire officer who can easily give a coarse-grained explanation for why a house burned down. The officer's understanding is shallow because the explanation is not very rich or detailed. As they argue, coming up with such an explanation only requires *average* intellectual effort or ability (Carter and Gordon 2014, p. 6). According to them, this is a problem for Pritchard because he is committed to the claim that (Carter and Gordon 2014, pp. 4–5, italics omitted):

[...] the obstacle of piecing together the information relevant to acquiring understanding-why [...] is an obstacle not easily overcome for one with merely average ability. For if it were, then we couldn't infer from the fact that one didn't overcome a significant obstacle in attaining understanding-why, that, therefore, she must have exhibited significant skill. [...] [So,] [...] the piecing together of information needed for understanding-why is akin to a difficult golf shot.

My issue with this objection is twofold: *First*, requiring that the relevant obstacle must be significant to accomplish a CAS does not imply that the obstacle cannot be easily overcome by an agent with merely *average* ability or effort. That would be too strong a demand. Achievements are defined *agent relatively*. I, for instance, have at best average abilities when it comes to playing billiards. But it nonetheless took me training to acquire these average abilities. When I hit any ball with a cue this should count as an achievement in the strong sense, even though it only requires average abilities. *Second*, the requirement that the obstacle should be akin to a *difficult* golf shot does not seem merited, given Pritchard's motivation for introducing the strong achievement notion. That notion only precludes that one overcomes the significant obstacle with *ease* without applying a significant level of ability. But there is space between 'with ease' and 'difficult.' Easy achievements can be excluded without demanding a difficult obstacle. Raising one's arm in *normal* conditions involves a non-significant obstacle, but does not demand the application of a significant level of ability.

So, Carter and Gordon's objections are rebutted. But keep the example of coarse-grained explanations in mind. I explain below why they nonetheless do pose a problem.

Grimm argues that cases featuring the simple (*p* because *q*) propositions mentioned earlier, like 'The house burned down because there was faulty wiring,' are counter-examples to Pritchard's thesis because they can be acquired solely via *testimony* (Grimm 2012, p. 111): Someone who understands why the house burned down can "[...] come to share his understanding of why the house burned down" by telling someone else that it burned down because there was faulty wiring. So, one can gain understanding-why via testimony. If Pritchard's testimony-objection is correct, understanding-why is thus not a kind of CAS. Whiting gives a similar argument. He argues that the subject does not have to piece together the (*p* because *q*) information herself, but can acquire it pieced together via testimony (Whiting 2012, p. 222).

Although they are right that a (*p* because *q*) proposition can be acquired as whole via testimony, this objection is not promising. According to Pritchard, in such cases no understanding-why has been gained. As we have seen, merely knowing that (the house burned down because there was faulty wiring) does not come with an answer to the vertical follow-up question. So, from Pritchard's point of view, no understanding-why has been gained. Grimm and Whiting could either deny that answering the follow-up question is necessary for understanding-why or deny that there is (*p* because *q*) knowledge without information about the explanatory relation. The first option would reject a widespread assumption, and so would presumably leave us quarreling about intuitions. The second option has been rebutted in Sect. 5.

Yet, Grimm's and Whiting's testimony objection can be combined with Carter and Gordon's second example to generate a real counter-example: Recall that Pritchard allows for limited

understanding-why which is based on rudimentary explanations for why p . Imagine that a reliable and knowledgeable person tells Tina a rudimentary explanatory story of how the chopping of onions led to watering eyes: the chopping of onions released an irritant gas which stimulates tears. Acquiring the content of such knowledge should fulfill Pritchard's condition for limited understanding-why, because the subject acquires an answer to the vertical follow-up question. It seems also clear that such a rudimentary explanation can be fully acquired via testimony. Such an explanation is so simple that understanding it does not require more than understanding a complex sentence (in contrast, perhaps, to understanding complex explanations). If so, understanding-why can be acquired solely via testimony; and so is not a kind of CAS.

Pritchard could argue that *limited* understanding-why is not understanding-why proper. But Whiting gives an example that points to another counter-example (Whiting 2012, p. 220):

I see my son knocking a glass of milk and spilling its contents on to the floor. I thereby come to understand why there is milk on the floor—because my son knocked the glass and spilled the milk on to the floor.

Grimm provides a similar example: the inkwell spilled because it got struck (Grimm 2012, p. 111, footnote 32). What is noticeable about such cases? According to Whiting (2012, p. 220),

[i]n this case, I do not even have to put two and two together; that is, I do not have to find the link between my son's actions and the spilled milk; I simply see the spilling of the milk. The degree of cognitive ability exercised here is negligible.

I do not think that this is the right diagnosis. One must identify the link between the action and the milk on the floor. In Whiting's example the linking is just done very quickly. For a contrast, imagine that one notices the son's action *en passant* and later wonders about the milk on the floor. Here, the putting together might take longer. Whiting's and Grimm's examples are problematic for Pritchard's thesis for a different reason: a *very simple causal connection* is involved. It is so simple that the answer to the vertical follow-up question can be acquired effortlessly. How spilling milk on the floor explains why there is milk on the floor is a very simple story. Putting together such a story does not involve a significant obstacle and it can be acquired solely via testimony.

To sum up, understanding-why is not a kind of cognitive achievement in the strong sense because in cases of limited understanding-why and understanding-why featuring very simple causal connections, having a relevant explanatory story is not a cognitive achievement in a strong sense. Thus, (U-WHY \neq CAS) and (K-WHY (NON-SHALLOW)) \neq CAS).

7 A lesson to draw: What sets understanding-why apart from knowledge-why?

As we have seen, being a kind of cognitive achievement in a strong sense is not a feature that sets understanding-why apart from knowledge-why. It seems that (k-why \neq cas) and (U-WHY \neq CAS). Ordinary knowledge-why and shallow knowledge-why are not a kind of CAS because they can be acquired solely via testimony. Non-shallow knowledge-why involves the same epistemic grip Pritchard singles out as the reason why understanding-why is a kind of CAS.

So, if understanding-why is such a kind, non-shallow knowledge-why is one, too. Yet, cases of rudimentary explanations or cases of very simple causal connections show that neither non-shallow knowledge-why nor understanding-why is a kind of cognitive achievement in a strong sense. They can also be acquired solely via testimony.

Although being a kind of cognitive achievement is not a distinguishing feature, I made the case for a distinguishing feature throughout the paper: If knowing why p is to know that (p because q), for some q , the minimal condition for understanding-why and knowledge-why with respect to their *contents* is not identical. Knowing why p requires information that some explanatorily relevant dependency obtains. Understanding why p additionally requires information about the principles or facts that establish the explanatory connections between the phenomena in question. In other words, whereas understanding why p requires an answer to the vertical follow-up question, knowing why p does not.

Footnotes

1. For other defenses of anti-reductionism about understanding-why see, e.g., Zagzebski (2001); Kvanvig (2003); Elgin (2007); Hills (2009, 2016); Dellsén (2017). For defenses of reductionism see, e.g., Lipton (2004); Grimm (2006, 2014); Khalifa and Gadowski (2013); Kelp (2014); Riaz (2015); Sliwa (2015).
2. I use round brackets to avoid scope ambiguities with respects to ‘know’.
3. Pritchard seems to understand these options as exclusive (cf. Pritchard 2010, p. 68). But they are not: there are cases where skill and a significant level of ability are involved, e.g., a marathon victory by a skilled runner.
4. Knowledge-*wh* is typically analyzed in terms of true answers to the so-called embedded *wh*-question (see, e.g., Karttunen 1977; Groenendijk and Stokhof 1982; Higginbotham 1996; Stanley and Williamson 2001; Braun 2006; Schaffer 2009; Mastro 2010; for an alternative account see, e.g., Brogaard 2009).
5. For general arguments for (k-that == cas) see so-called *robust virtue epistemology* accounts (e.g., Zagzebski 1996; Sosa 2007; Turri 2011; Greco 2012; Kelp 2014; Carter et al. 2015; Navarro 2015).
6. Grimm argues that k-why (common analysis) captures one kind of knowledge-why and that there is another kind of knowledge-why (Grimm 2014). However, he does not reject the common analysis.
7. However, a full-fledged account of knowledge-why must deal with the following issues: (i) Some answers to why-questions have as their canonical form (p in order to q) propositions. So, one must show that for each (p in order to q) proposition there is an equivalent (p because q^*) proposition, or one must define knowledge-why more broadly. (ii) It has been argued that why-questions are inherently *contrastive* (e.g., Fraassen 1980, chapter 5). One must either refute this claim or take it into account.
8. One explanation is that causal claims are *contrastive*. Whether the bald tire or the driver’s drunkenness is the cause of the crash seems to depend on the contrast in question. The

contrast might be that the driver had a crash with *this car* rather than with some other or that *this driver* rather than some other had a crash, etc. For details, see, e.g., Dretske (1977); Achinstein (1983), chapter 6; Hitchcock (1996); Schaffer (2013).

9. The *horizontal* follow-up question in case of (*p* because *q*) is ‘Why *q*?’ (Skow 2016, pp. 79–80).
10. Skow considers vertical follow-up questions to be (equivalent to) particular *why*-questions, namely ‘Why is it the case that *F* is a reason why *E* happened?’ (cf. Skow 2016, p. 74). Pritchard varies between talking about how cause and effect are related and “[...] some conception of why introducing oxygen might cause the target chemical reaction [...]” (Pritchard 2014, p. 323). This varying between what, how, and why is commonplace in theories of explanations.
11. As one reviewer emphasized, information about facts or principles that establish the explanatory connection is information about a *subject matter*. If so, understanding-why threatens to collapse into so-called *objectual* understanding, i.e., understanding of a subject matter, such as understanding Obama’s victory in 2008 (for more on this topic, see, e.g., Kvanvig 2003, chapter 8; Elgin 2007; Grimm 2011; Carter and Gordon 2014; Baumberger and Brun 2017). However, such a (potential) collapse is an issue for *all* accounts that tie understanding-why to *explanations*. The expression ‘information about facts or principles that establish the explanatory connections between the phenomena’ is a characterization of the essence of any explanation that goes beyond identifying the cause. In the case of causal explanations such explanations are taken to be descriptions of complex phenomena, such as causal processes. I think this is why Elgin remarks that “[...] it is the conception of [objectual] understanding that is closely connected to explanation.” (Elgin 2007, p. 35) It thus does not seem obvious to me whether the (potential) collapse is a *threat*. Instead, it needs to be discussed how similar understanding-why and objectual understanding are (see, e.g., Grimm 2011), or whether objectual understanding is explanatory understanding (see, e.g., Khalifa 2013). But this is not my agenda in this paper.
12. Such knowledge-how is not a form of *practical* knowledge-how, such as knowing how to swim. It also seems clear that such knowledge-how can be spelled out in terms of propositional knowledge.
13. For those who worry that my account of non-shallow *knowledge-why* is a reductive account of *understanding-why* in disguise: Non-shallow knowledge-why and understanding-why could differ in other respects. For instance, understanding-why might demand particular abilities (see, e.g., Hills 2016) or a particular cognitive attitude (see, e.g., Strevens 2013), etc.

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