

Empirical evidence and the knowledge-that/ knowledge-how distinction

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Abstract In this article I have two primary goals. First, I present two recent views on the distinction between knowledge-that and knowledge-how (Stanley and Williamson, *The Journal of Philosophy* 98(8):411–444, 2001; Hetherington, *Epistemology futures*, 2006). I contend that neither of these provides conclusive arguments against the distinction. Second, I discuss studies from neuroscience and experimental psychology that relate to this distinction. Having examined these studies, I then defend a third view that explains certain relevant data from these studies by positing the double dissociation of knowledge-that and knowledge-how and that is also able to do explanatory work elsewhere.

Keywords Epistemology · Knowledge-that · Knowledge-how

0 Introduction

There has been discussion recently about the distinction between the concepts ‘knowledge-that’ and ‘knowledge-how’. For many, there is an intuitive reason that seems to motivate the distinction. We seem, after all, to know skills in a way different from the way in which we know facts, so there must be a difference between the two. Although the debate over the distinction occurs in epistemology, the distinction has been employed outside of epistemology (see, e.g., the defense of physicalism in [Lewis 1990](#)). As a result, the debate has far-reaching implications.

Some philosophers have attempted to undermine this distinction. In Sect. 1, I examine Jason Stanley and Timothy Williamson’s paper ([Stanley and Williamson 2001](#))

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that makes use of linguistic analysis to argue that knowledge-how is a species of knowledge-that (hereafter S&W). I also discuss a recent response to S&W's paper by Stephen Hetherington (2006)¹ that criticizes their article and presents a positive case for knowledge-that being reducible to knowledge-how by making use of conceptual analysis.² I show both to offer inconclusive arguments against the distinction. In Sect. 2, I discuss studies in neuroscience and experimental psychology that make a distinction between these two types of knowledge. I argue that neither S&W's nor Hetherington's theory is best able to explain certain relevant data related to studies involving patients with memory impairments. I then defend a third view that explains these phenomena by hypothesizing the double dissociation of knowledge-that and knowledge-how and that is also able to do additional explanatory work in the disciplines of neuroscience and developmental psychology.

1 Recent discussion of knowledge-that and knowledge-how

Before detailing each of these contemporary papers, it will first be useful to discuss briefly Gilbert Ryle's argument to which both of these recent papers refer. As one writer has noted, "[i]t seems almost churlish to discuss the concept of 'knowing how' without at least mentioning the name of Gilbert Ryle" (Carr 1979, p. 394). Ryle believed that knowledge-that and knowledge-how were different types of knowledge, such that if one were to confuse or conflate them she would be making a category mistake (Ryle 1949, 1971). Ryle essentially saw himself as refuting what he called the "intellectualist legend," which he characterized as espousing the following view:

To do something [while] thinking [about] what one is doing is, according to this legend, to consider certain propositions, or prescriptions, and to put into practice what these propositions or prescriptions enjoin. It is to do a bit of theory and then to do a bit of practice (Ryle 1949).

Ryle's primary argument against the "intellectualist" view is that it leads to a vicious regress. On the face of it, this seems obvious given Ryle's characterization of the view; for if one had to contemplate a proposition in order to perform an intelligent action, it seems that this contemplating would also be an action requiring the contemplating of a proposition and so on and so on (cf. Ryle 1971, p. 213). Ryle's view will not be the focus of this paper, so I will move on, but it is important to note that many philosophers since Ryle have simply granted this distinction.³

¹ Other recent discussions of the distinction include Snowdon (2003); Noë (2005); Koethe (2002); and Moffett and Bengson (2007). These recent papers all, in some way, critique S&W's paper "Knowing How."

² The distinction in this case between these two methods, i.e., conceptual analysis and linguistic analysis, is that the former begins with a definition and then uses thought experiments to explicate the necessary and sufficient conditions for a given concept and the latter appeals to linguistic theory.

³ Following Ryle, researchers working in artificial intelligence became interested in the distinction (the distinction in this field, as in psychology, was between declarative and procedural knowledge). The debate in artificial intelligence concerned whether programmers should code using declarative representation or procedural representation. For a discussion, see Gardner (1985, pp. 161–162). Following this debate, though, it was discovered that one could represent the same knowledge using either type of coding. Researchers in other fields realized later, as will be discussed in the latter parts of this paper, that the distinction is helpful

1.1 S&W's "Knowing how"

S&W have two primary goals in their paper: first, to demonstrate that Ryle's argument against intellectualism is unsound; and second, to provide a positive account that places no significant distinction between knowledge-that and knowledge-how by appealing to linguistic analysis. The latter will dominate this discussion.

Regarding the former objective, S&W believe that the problem lies in interpreting the two instances of 'action' in the above description of the vicious regress. More formally, the authors reconstruct Ryle's account as follows (413):

- (1) If one F s, one employs knowledge how to F .
- (2) If one employs knowledge that p , one contemplates the proposition that p .

Next, the authors make use of an assumption for reductio to force the argument into a regress. Given the above premises, if knowledge-how is a species of knowledge-that, then the content of knowledge how to F is, for some φ , the proposition $\varphi(F)$. The reductio is as follows:

RA: knowledge how to F is knowledge that $\varphi(F)$.

With these reconstructions, and by designating the act of contemplating with 'C', S&W formally represent Ryle's claim that the "intellectualist" view is guilty of vicious regress. That is, they are able to show, after multiple applications of premises 1 and 2, that knowledge should never occur; formally this looks like ' $\dots C(\varphi(C(\varphi(C(p))))))$ '. The problem, however, lies in how to understand the action occurring in each of the premises. S&W contend that "[t]here is no uniform reading of the two premises on which both are true; the argument is unsound" (p. 416).

With regard to the first premise, Ryle certainly wants to restrict the sorts of actions that are relevant to this discussion. For example, as S&W note, Ryle excludes automated actions such as digestion. If actions such as digestion were relevant, then when one digested food we would have to say that she knew how to digest food. Clearly, it is not the case that we possess some knowledge which is a necessary condition for our digesting food; rather, we have automated processes that perform this action for us.

In this regard, Ryle (1949, p. 30) limits the discussion to include only those actions which are "intelligent". Another instance this qualification rules out is accidentally doing something, e.g., winning a raffle. There is one sense in which the winner knows something about how to win a raffle (i.e., that a necessary condition to win is to buy a ticket), but there is another sense in which the winner does not know how to win (i.e., how not only to fulfill the necessary condition but also how to fulfill the sufficient condition). The latter sense is what excludes cases like winning a raffle from this discussion. Another example might be the beginning diver who completes a difficult dive for the first time, but who does so by luck; in some sense it seems we would want to avoid saying that he really knows how to perform this dive. So, what does Ryle

Footnote 3 continued

when understanding brain functioning. The history of the distinction, though, is not the focus of this paper, so it will not be discussed further.

intend by the term ‘intelligent’? S&W take him to mean actions that are ‘intentional’. I see no problem with limiting the first premise to intentional actions.

With regard to the second premise, S&W draw support from Carl Ginet’s work *Knowledge, Perception and Memory*. Here Ginet argues that when one “exercises” knowledge to perform a particular action (e.g., Ginet references knowledge related to the action of opening the door) she is able to do so without “formulating that proposition or any other relevant proposition” (Ginet 1975, p. 7). S&W then conclude that since the act of contemplating need not be an intentional act, it cannot be a substitution instance for *F* in premise 1 above, thus halting Ryle’s accusation of a vicious regress.⁴ I have no objection to this critique of Ryle’s vicious regress argument, so I will proceed to discuss S&W’s second goal, namely, to provide a positive account of the distinction between knowledge-that and knowledge-how by appeal to linguistic analysis.

S&W begin their linguistic analysis with the following two sentences (p. 417):

- (1) Hannah knows how to ride a bike.
- (2) Hannah knows that penguins waddle.

On the face of it, there does appear to be a syntactic difference between these two sentences. The first sentence has an infinitive as the complement to ‘know how’ and the second has a proposition as the complement to ‘knows that’. Highlighting these two sentences in this way, though, requires ‘know how’ to be a distinct constituent with an infinitive as the complement, while requiring ‘know’ in the second sentence to have no causal complement but rather to have an object, namely, the proposition ‘that penguins waddle’.⁵ This may initially seem appropriate from the perspective of making a philosophical distinction, but as S&W argue, this flies in the face of what is argued in most contemporary linguistic theory about sentence structure (p. 417).

Rather than relying on ‘know how’ forming a distinct constituent, S&W encourage the view that ‘know how’ constructions are no different from any other sentence containing ‘know’ and an embedded question such as ‘how to ride a bike’. So, for example, on this view, there is no syntactic difference between sentence (1) above and the following sentences:

- (3) Hannah knows where to find a nickel.
- (4) Hannah knows whom to call for help in a fire.⁶

This view is in agreement with how most linguists distinguish the syntactic structure of sentences with embedded questions, and on this view there is no syntactically relevant difference between (2) and (3)–(4). If sentences containing ‘know how’ should not be treated as syntactically unique from other sentences containing embedded questions,

⁴ See Noë (2005) for a nuanced view of handling premise 2. Here, Noë argues that Ryle would not have to grant that ‘contemplating’ is non-intentional (*Ibid.*, p. 282). It may be unconscious, but this does not entail that it is non-intentional like digestion. This distinction appears to give Ryle a way out of S&W’s critique, but I will not continue on this topic since my focus will be the positive account S&W provide.

⁵ S&W explicitly appeal to Bechtel and Abrahamsen (1991, pp. 151–152) as philosophers who write about this “linguistic distinction.” What S&W do not note, however, is that Bechtel and Abrahamsen do not believe that appealing to such a linguistic distinction alone is *conclusive*, which is exhibited in the following quotation: “This linguistic distinction does not, however, settle the matter as to whether there are different psychological distinctions involved” (*Ibid.*, p. 151).

⁶ In addition, S&W discuss sentences with embedded questions beginning with ‘which’ and ‘why’ (p. 418).

and this is precisely S&W's point here, then the way that an ascription of knowledge-how should be analyzed should be no different from the way that any other sentence with 'know' followed by an embedded question is analyzed.

It is impossible to discuss all of the finer details of S&W's paper, but there are two additional points worth noting that relate to their treatment of knowledge-how as analogous to uses of 'know' with an embedded question. First, on this view there is no syntactic difference between knowledge-that and knowledge-how ascriptions, since both have 'know' taking a sentential complement. Second, the way S&W are able to draw an analogy between knowledge-how ascriptions and knowledge-that ascriptions is by appealing to Lauri Karttunen's theory of embedded questions, i.e., that an embedded question "denotes the set of its true answers" (420). So, on this view, two related elements displayed in the following sentence are relevant:

(5) Hannah knows how PRO to ride a bicycle.

The first element is 'PRO', which is "an empty pronominal element that occurs in the subject position of infinitives in English (420)." The antecedent of 'PRO' in some contexts is determined by the subject of the sentence ('Hannah' in this case), but in other instances it should be understood in a generic sense as 'one'. The second element relates to how to interpret the infinitive; it can be understood as an 'ought' or a 'could' reference. The relevant interpretation of (5) for S&W's argument that incorporates both of these elements (i.e., the antecedent of 'PRO' as determined by the subject and the infinitive interpreted as 'could') for knowledge-how ascriptions is as follows:

(6) Hannah knows how she could ride a bicycle.

Here, as noted above, the embedded question, i.e., 'how she could ride a bike', denotes the set of its true answers. It is this use of Karttunen's theory of embedded questions that paves the way for S&W to argue that knowledge-how is a species of knowledge-that.

On S&W's view, for Hannah to know how to ride a bike is for her to know the set of true answers related to ways in which she could ride a bike (here S&W avoid trouble by limiting this set to a contextually relevant set that may vary from situation to situation).⁷ With these parameters defined, S&W are then able to provide their analysis of knowledge-how ascriptions as follows: for Hannah to know how to ride a bicycle is for Hannah to know that some way *w* is a way for Hannah to ride a bicycle (p. 425).

At the end of their analysis, S&W argue that the great attention paid to the concepts knowledge-how and knowledge-that is unfounded, since from a linguistic standpoint these two constructions are not at all unique. The following claim is illustrative of their view:

...we recognize the possibility that the enormous amount of attention philosophers have directed to this linguistically rather ordinary construction may be

⁷ Without limiting this set to a "contextually relevant" one, S&W would be faced with the objection that there are just too many things in the set, especially with difficult skilled performances. On S&W's view, Hannah knowing how to ride the bicycle means that there is a contextually relevant set of true answers which for someone else, e.g., a professional bicyclist, would be different (i.e., the bicyclist would have a larger, different set).

motivated by special features to which linguists have been inexplicably blind” (p. 432).

Then they argue that their view is to be preferred since it follows from the “basic facts about the syntax and semantics of knowledge-how ascriptions” and also because it explains features that other accounts are unable to explain (p. 441).

1.2 Hetherington’s “how to know (that knowledge-that is knowledge-how)”

Stephen Hetherington believes that S&W’s analysis goes in the wrong direction.⁸ Rather than knowledge-how being a species of knowledge-that, Hetherington argues in the opposite direction by contending that knowledge-that is *reducible* to knowledge-how.⁹ To accomplish this goal, Hetherington first attacks S&W’s criticism of Ryle’s vicious regress argument that was discussed above. Second, Hetherington provides a positive account of what he calls the “knowledge-as-ability” thesis. I will discuss only Hetherington’s second objective since his positive account most directly relates to my thesis.

Hetherington’s primary objective is to provide a positive account of knowledge-that as reducible to knowledge-how. Hetherington believes that, although Ryle was correct in arguing against the intellectualist position, Ryle was wrong in his conclusion that knowledge-that and knowledge-how are distinct categories. Rather than appealing to linguistic analysis, Hetherington appeals to conceptual analysis. The difference between the two in this instance seems to be that, rather than appealing to the structure of language, conceptual analysis aims to fill out the necessary and sufficient conditions of knowledge-that in terms of knowledge-how by providing examples and thought experiments. Since Hetherington aims to provide a reduction of knowledge-that to knowledge-how, all knowledge ascriptions in terms of knowledge-that are reduced to ascriptions in terms of knowledge-how.

Hetherington’s strategy is fairly straightforward. He provides a definition and then provides thought experiments to encourage intuitive responses that support his case. Hetherington provides the following definition:

When you know that *p*, you have an *ability*—in that sense, you know how—to represent or respond or report or reason accurately that *p* (where in general these potential outcomes need not be publicly verifiable) (2006, pp. 74–75).¹⁰

⁸ Hetherington acknowledges he is not the first to make this claim. For other examples, see Hartland-Swann (1956, 1957). For a critique of Hartland-Swann, see Ammerman (1956).

⁹ Hetherington (2006, p. 72) calls S&W’s argument a “recent attempted reduction”, but S&W claim their view is not a reduction (pp. 433–434). Whether or not S&W’s view is a reduction will not matter for my argument. The main point here is that S&W and Hetherington each arrive at a conclusion that seeks to dissolve the distinction between knowledge-that and knowledge-how, but that they each reduce in a different direction.

¹⁰ Note: Throughout his paper, Hetherington uses the non-standard, ungrammatical locution ‘know-that’. In my summary of his argument in this subsection I follow his convention, but otherwise I have used ‘knowledge-that’.

On many epistemological accounts, there may be corresponding abilities that are correlated with possessing knowledge, but these are not knowledge itself; rather, they are part of what generates the knowledge or comes with it. On these accounts, having a certain ability (e.g., to know that p) does not imply knowing that p , since the ability may never be manifested (Hetherington 2006, p. 75). Hetherington wishes to counter this implication by offering two qualifications to the definition provided above.

First, when Hetherington states that to know that p is to know how to know that p , he emphasizes that he does not intend that the subject can merely know whom to ask about the status of p (Hetherington 2006, p. 75). This ability to know that p must be one that the knowing subject presently possesses. Second, this ability is not something that may carry into the future. For example, if the subject possesses the ability to know that p in two days, from this it does not follow that the subject knows that p ; rather, Hetherington claims that for one to know that p one must have the ability *now* to know that p (Hetherington 2006, p. 75).

Hetherington then provides a thought experiment designed to illustrate these two qualifications. Here is the thought experiment. Imagine that there is a piece of gum under the desk in which you are presently sitting. In one sense you are *able* to observe the gum, but in another sense you are not. Regarding the former sense, you are able to observe the gum because you possess the physical ability to angle your head around and see the underside of the desk. Regarding the latter sense, you are not able to observe the gum because you are not *presently* (now) able to see the gum, so in this latter sense you are not *now* able to know that p . Hetherington (2006, p. 75, fn. 8) makes the following point: “My knowing now of the gum’s presence is my being able to observe it now”. This thought experiment illustrates how, on Hetherington’s account, one must currently possess the ability to know that p for one to know that p .

Having made these qualifications clear, Hetherington provides the following analysis of knowledge-that in terms of knowledge-how: “You knowing that p is your having the ability to manifest various accurate representations of p . The knowledge as such is the ability as such” (2006, p. 75). Hetherington acknowledges that this version of knowledge prevents knowledge from being a belief, or at the very least it prevents it from being an occurrent belief. He calls this hypothesis the “knowledge-as-ability” hypothesis (2006, p. 76). In the sections that follow, Hetherington provides justification for his hypothesis, showing how he believes it could fit within both internalist and externalist frameworks, as well as arguing that it might help epistemologists respond better to Gettier examples. The application of his hypothesis to these specific areas in philosophy will not be the focus of the rest of this paper, since the primary aspect of his view that applies to the topic at hand is his attempted reduction of knowledge-that to knowledge-how.

In Sect. 1, I have presented two theories which both argue against the distinction between knowledge-that and knowledge-how. Both theories do so by *a priori* analysis, one with conceptual analysis and the other with linguistic analysis, and each provides a different denial of the distinction. Since these *a priori* analyses have provided no reason to accept one of them over the other, in Sect. 2 I will examine empirical data that I believe will help adjudicate the debate.

2 Knowledge-how and knowledge-that: different after all

The problem, as I see it, is that the S&W and Hetherington have given us no principled reason for preferring one of their positive accounts of the distinction over the other. As theories, it seems the best way to decide between them, or to reject both of them, is by determining which of them best explains relevant data, i.e., by determining which theory has greater explanatory power.¹¹ An additional way to help one choose between them (or reject both of them) is to determine which does more explanatory work in related disciplines that could, presumably, make use of their theories such as, for example, neuroscience or developmental psychology.

In this section, I will provide studies from experimental psychology and neuroscience suggesting that, in fact, both S&W and Hetherington may be wrong, and that Ryle's view may be correct. I will argue that S&W and Hetherington provide theories about the distinction between knowledge-that and knowledge-how that do not best explain certain phenomena related to knowledge and memory. The third theory I will discuss explains both behavioral and neuropsychological phenomena by positing the double dissociation¹² of two distinct memory systems; this theory is best able to explain these phenomena. In addition, I will briefly examine how the theory that posits the double dissociation of these two types of knowledge is able to do explanatory work in both neuroscience and developmental psychology that S&W's and Hetherington's are unable to do.

2.1 Two types of memory and double dissociation

There is a long tradition in experimental psychology that makes a distinction between two types of memory that are related to learning, i.e., declarative memory and procedural memory (these types of memory store declarative knowledge and procedural knowledge, which map onto what philosophers mean when they talk about knowledge-that and knowledge-how, respectively).¹³ Since both S&W and Hetherington have argued that there is no significant distinction between the two, studies in these areas that do make a distinction are clearly relevant to the debate.¹⁴ On the view of the theory positing double dissociation, declarative memory stores declarative knowledge, i.e.,

¹¹ S&W appeal to explanatory power in their explication of their theory (p. 441). Hetherington seems to do this as well in the latter sections of his essay when he discusses how he believes his knowledge-as-ability thesis "helps us understand or resolve" cases like Gettier cases (cf. 85ff). What both neglect is empirical data related to knowledge-that and know-how that their theories must also explain.

¹² Double dissociation is not unique to this debate; rather, it is a common distinction in empirical psychology and neuroscience. To posit, for example, that two bodily functions exhibit double dissociation is merely to say that A is dissociated from B and B is dissociated from A. It is dissociation in both directions.

¹³ For an example of early work, see Cohen and Squire (1980). Also, for a more recent, comprehensive theory on the brain systems that work with memory see Cohen and Eichenbaum (1993).

¹⁴ S&W argue against the distinction and claim that knowledge-how is a species of knowledge-that. Hetherington argues against the distinction by claiming that all knowledge-that depends on knowledge-how. Thus, for Hetherington an ascription of knowledge-that can be *reduced* to an ascription of knowledge-how. In arguing for this reduction, Hetherington denies the robust distinction for which Ryle argued.

knowledge of facts and episodes, and procedural memory stores procedural knowledge, i.e., skill knowledge.

More recently, the distinction is made between declarative and non-declarative memory, with the latter including procedural knowledge as well as other types of knowledge that are distinct from declarative knowledge.¹⁵ For the purposes of this discussion, although there are other types of memory that fall under the classification ‘non-declarative’, I will primarily speak of a distinction between declarative and procedural knowledge (and memory). Such a distinction between declarative and procedural memory is motivated by a desire to explain behavioral phenomena and neuropsychological phenomena that result from memory impairments such as amnesia, Parkinson’s and Huntington’s, as well as phenomena relating to those without these impairments.

Before delving into the data from experimentation on individuals with these memory impairments, it is first important to discuss briefly one way in which the distinction between declarative knowledge and procedural knowledge is often made. When queried about a particular piece of declarative knowledge, a subject is often able to verbalize the memory easily, e.g., a memory of an event that happened. In contrast, with procedural memory subjects are often unable to recount how they actually went about doing a certain activity such as dunking a basketball. The difficulty in verbalizing seems to increase with the complexity of the skilled performance.

Another difference between these two types of memory is that with declarative memory information seems to be stored all at once, but with procedural memory the storage takes time.¹⁶ For example, learning how to ride a bicycle does not happen all at once; rather, it occurs in gradations. Learning a fact such as that Jim is 12 years old, however, seems to be learned all at once. It is important to note that from these considerations of the *prima facie* differences between declarative and procedural memory it does not strictly follow that they are *actually* different types of memory. Just because we are unable to articulate the knowledge related to performing a particular skill does not mean that there are not facts (i.e., propositions) involved in the skilled performance. S&W’s theory would certainly be able to explain this as a *prima facie* distinction merely having the appearance of a significant distinction.¹⁷ Stronger evidence for this distinction between declarative and procedural memory (and knowledge), it seems, is available in the data from behavioral and neuropsychological studies on individuals with memory impairments.

Perhaps one of the most famous cases of amnesia is the case of the patient H.M.¹⁸ H.M. had a condition that since the age of 16 had caused him to have seizures that were

¹⁵ See Squire (2004, p. 173). Also, note that there is a further subdivision of declarative memory into semantic and episodic memory, the former relating to memory of facts and the latter relating to events.

¹⁶ For a discussion of these *prima facie* differences, see Medin (2005, pp. 184–185).

¹⁷ In fact, S&W do respond to a similar sort of way to make the distinction (cf. 433). Here they answer this by arguing that the proposition(s) a subject knows in a know-how ascription can be captured by an indexical like ‘this’ or ‘that’. So, for example, if John knows how Sue rides a bike but he is unable to verbalize this knowledge he can still exhibit his (in S&W’s view) propositional knowledge with the statement “I know that Hannah rides a bicycle in this way.” He would say this while riding in the way that Hannah rides.

¹⁸ For an early discussion of H.M. see Scoville and Milner (1957); reprinted in the “Neuropsychiatry Classics” section of *The Journal of Neuropsychiatry & Clinical Neurosciences* 12.1 (2000): 103–113. Citations will be from the reprinted version.

impossible to regulate with medication. He was completely incapacitated from these seizures and, as a result, his family consented for him to have an experimental bilateral temporal lobe resection at the age of 27. After the operation, certain aspects of H.M.'s memory were severely impaired; most notably, as Scoville and Milner describe, H.M. was unable to remember day-to-day events right after the events occurred (Scoville and Milner 1957, p. 106). The interesting aspect of H.M.'s case is that, although he was neither able to learn and remember new facts nor able to remember his own age or where he was living, he was still able to improve in areas of skilled performance. The following quotation is illustrative of his condition:

...while preventing him from storing and/or using the data usually acquired as the outcome of one's learning experiences, nonetheless [his condition] leaves *intact* the ability to acquire and express skilled performances based on these same experiences (Cohen et al. 1993, p. 15; author's emphasis).

From studying H.M.'s condition, as well numerous similar amnesic patients with damage to the hippocampal system, researchers have concluded that there is a particular sort of memory that the anterograde deficit (i.e., the symptom of amnesia that prevents one from learning new information) affects, namely, declarative memory, while leaving other types of memory intact, such as memory related to skilled performance.

The key aspect of this research related to amnesic patients is that not only do certain skills remain intact that were available prior to onset of amnesia,¹⁹ but moreover that in cases like H.M.'s and numerous others there is actually the ability to improve new skills that are acquired after contracting amnesia, despite lack of declarative knowledge of the training or of the new skills acquired. For example, an experiment in 1980 measured the abilities of amnesic patients in reading words that were reflected in a mirror so that they appeared backwards (Cohen and Squire 1980). Prior to this study, there was already evidence that amnesic patients were able to acquire and improve perceptual-motor skills, but this experiment was designed to determine if, in addition, amnesic patients were able to acquire and improve upon skills that were more cognitive in nature (i.e., in this instance the cognitive skill was pattern-recognizing). The image below is an example of one of the word triads that Cohen and Squire provided to these patients and the control group.

bedarled—cariciora—gnirg

In this experiment, subjects were given series of word triads such as the one above. As one reads these word triads, one develops the ability to recognize patterns in letter grouping, and reading becomes significantly easier. The data from this experiment suggests that amnesic individuals were able to acquire pattern-recognizing skills at a normal rate.

¹⁹ For a recent biographical account of such a case where musical ability was not hampered even with the onset of severe amnesia (inability to preserve new memories combined with severe retrograde amnesia) see Sacks (2007).

An interesting difference between the control group and the amnesic group was that, although the individuals in the amnesic group were able to read unique (non-repeated) words at roughly the same performance level as the control (i.e., each group got progressively better at roughly the same rate as the experiment progressed over 3 days and then 90 days later), they were inferior to the control group in reading words that were repeated because they did not remember the specific words from previous instances. This last finding strongly suggests that these individuals lack declarative memory, and that there is dissociation between declarative and procedural memory.

There have been numerous other studies with amnesic patients demonstrating their ability to learn and improve skills while possessing no declarative knowledge whatsoever about the skills or training.²⁰ As a result, researchers have argued that the hippocampus and related structures in the medial temporal lobe,²¹ which is affected by amnesia and other related memory conditions, supports declarative memory. The case of H.M. and of other similar amnesic patients provides both behavioral and neuropsychological evidence to support dissociation between declarative and procedural knowledge; the behavioral evidence is their inability to acquire declarative knowledge while still being able to acquire and improve procedural knowledge, and the neuropsychological evidence is the connection this impairment has with the hippocampal system.²²

The evidence presented so far demonstrates that one may possess and acquire new skill knowledge and memory even if one's ability to possess and acquire new declarative knowledge is largely impaired or completely prevented. Additional studies with those lacking memory impairments lead to the same conclusion.²³ These studies provide evidence to support the dissociation of procedural knowledge from declarative

²⁰ See, for example, [Nissen et al. \(1989\)](#). Another study found that amnesic patients learned a particular probabilistic task at the same rate as the control group, but that the amnesic patients had difficulty determining whether other tasks that were described to them instantiated the same skill. The conclusion of the study was that subjects in the control group acquired declarative knowledge (characterized by its plasticity) after learning the skill and were able to generalize this knowledge, while the amnesic group failed to acquire this knowledge. This fits with the general characterization of procedural knowledge as non-plastic and restricted in its application. For this study see [Reber et al. \(1996\)](#).

²¹ These related structures include perirhinal, entorhinal, and parahippocampal cortices. Thanks to an anonymous reviewer for this connection to these related structures.

²² It is important to note that some types of amnesia may be caused by damage to areas of the brain other than the hippocampal system. The possibility of similar symptoms resulting from non-hippocampal amnesia is not problematic, though, for the view that the two types of knowledge are double dissociated. The primary issue is that when the hippocampal system is damaged there is impairment of declarative memory. For discussion see [Cohen and Eichenbaum \(1993\)](#), pp. 42–45). For a general overview of cases of amnesia following damage in the hippocampus see [Spiers et al. \(2001\)](#). This article notes that there has been consensus in the field that amnesia due to damage to the hippocampal system does preserve non-declarative memory such as procedural memory (p. 359).

²³ For example, in a 1989 experiment subjects were given no declarative information prior to participating in an exercise in artificial grammar. One of the conclusions of this experiment was that subjects were able to learn to accomplish tasks without being able to verbalize the rules; the experimenters concluded that this leads one to believe that in non-impaired individuals there is also a dissociation of declarative and procedural knowledge. See [Reber \(1989\)](#). Studies like this argue less persuasively than studies where there is a corresponding neuropsychological claim such as hippocampal system impairment, since in the latter there is the *in principle* inability to learn declarative knowledge; combined with the latter, though, these studies do support a view that there is a dissociation of declarative and procedural knowledge.

knowledge. This, however, only shows single dissociation, i.e., it demonstrates that it is possible to acquire and improve procedural knowledge in the absence of declarative knowledge.

Theorists have also posited the dissociation of declarative knowledge from procedural knowledge. There is less evidence to suggest the dissociation in this direction, but the data are suggestive of this dissociation. Here studies have indicated that individuals with Parkinson's and Huntington's disease have difficulty acquiring skill knowledge but seem to have no impairment in the acquisition of declarative knowledge. In one particular study, subjects with Parkinson's disease showed difficulty acquiring skill knowledge, but they were unimpaired in the acquisition of declarative knowledge.²⁴ In addition, this double dissociation between memory systems in the brain (here we have been considering only two systems, i.e., declarative and procedural) is also exhibited in other animals such as rats and monkeys, leading many to suppose that there are commonalities in this functioning of the brain across species.²⁵

Due to its appeal to different brain systems that support two types of memory and two corresponding types of knowledge, the theory that appeals to the double dissociation of declarative and procedural knowledge is best able to explain the phenomena occurring in patients with amnesia and diseases such as Parkinson's. Though it seems that this theory best explains the evidence, there are several ways in which S&W and Hetherington might respond to the interpretation of the evidence from these studies. I now want to consider some objections each might have in an attempt to vindicate their analyses.

2.2 Responses and replies

When attempting to explain the phenomena discussed in the previous section, S&W and Hetherington each have two possible ways of attempting to provide an explanation. Since I anticipate each responding in a similar manner, I will discuss only how I believe S&W might respond, but what I say with regard to their argument will apply *mutatis mutandis* to Hetherington's argument. The two possible ways S&W might attempt to explain these phenomena are as follows: first, they might argue that, when viewed in the light of their linguistic analysis, the empirical studies mentioned above merely suggest that there two different types of knowledge—that, i.e., two distinct species under the genus of knowledge—that; and second, they might argue that the data from these

²⁴ For a discussion of Parkinson's see, for example, Heindel et al. (1989). It is important to note that for many theorists procedural memory is not just one, unified thing. For many (e.g., see the chart in Squire 2004, p. 173), the primary distinction between memory systems is between declarative and non-declarative memory, with the latter including priming and perceptual learning, simple classical conditioning and nonassociative learning in addition to procedural learning. The simple division between declarative and procedural memory discussed in this paper has been warranted in this paper since the primary goal has been to establish, *contra* S&W, that positing *these* two systems as distinct both best explains certain phenomena and does further explanatory work in cognitive neuroscience. Current debates regarding memory systems allow for multiple distinct systems under "nondeclarative" in addition to procedural memory, but these further subdivisions are not germane to the topic of this paper.

²⁵ See Squire (1992) and DeCoteau and Kesner (2000).

studies can be explained as mere capabilities, a category which S&W grant as distinct from knowledge-that.

With regard to the first response, S&W might argue that the empirical evidence presented in these studies shows only that there are distinct types of *knowledge-that* involved in human cognition. So, on this line, there is one type of knowledge-that involved in what neuroscientists call declarative knowledge and there is another type of knowledge-that involved in what neuroscientists call procedural knowledge. In other words, if S&W were to grant that the empirical data discussed in this paper encourages such a distinction to be made between declarative knowledge and procedural knowledge, then they might still move up a level and claim that both are still different types of knowledge-that.

Granting this distinction, though, and then moving up a level would severely harm their argument since it would make more of the difference between the knowledge-that and knowledge-how than S&W want to allow. It would, to mirror a worry they mention, recreate the Rylean traditional distinction. The following quotation illustrates S&W's worry:

If the special subclass of knowing-that which we call 'knowing-how' is too dissimilar from other kinds of knowing-that, then one might suspect that we have just recreated the traditional distinction between knowing-how and knowing-that, but in other terms. So it must be that, on our analysis, knowing-how possesses the characteristic features of other kinds of knowing-that (p. 434).

Following this quotation, S&W provide what they believe to be an instance in which knowledge-how is subject to a Gettier case, thus providing (they believe) an example of a structural similarity between knowledge-that and knowledge-how.

Without entering into the debate of whether knowledge-how is subject to Gettier cases, it seems most important to note that the empirical studies discussed earlier in this paper do provide characteristics that signal key differences between knowledge-that and knowledge-how. One key difference between the two that these empirical studies support is the characterization of knowledge-that as plastic and knowledge-how as rigid in its application. If S&W attempted to explain the empirical studies mentioned above by claiming that each is merely a type of knowledge-that, it seems that the distinction between plasticity and rigidity would still remain and perhaps recreate the Rylean distinction. For example, if I possess (declarative) knowledge of some proposition there are no restrictions on my applying it wherever relevant. I can take that declarative knowledge and use it when and where needed. There are restrictions, however, with procedural knowledge (this distinction will be discussed more below). I may be able to apply the procedural knowledge in a few contexts, but I will be unable to abstract principles from it and apply it without the aid of declarative knowledge.

This key difference between procedural and declarative knowledge directly relates to S&W's desire to demonstrate that knowledge-how is a species of knowledge-that. In their discussion of what it means for one concept to be a species of another, S&W provide the example of 'assassinate'. For a concept to be a species of another concept, both must share some essential characteristic. So 'assassinate' and 'kill' both must both possess some essential characteristic (or characteristics) for the former to be a species of the latter. It seems plausible that the analysis of knowledge should include

characteristics relating to both the acquisition and application of knowledge. It is on the latter analysis, i.e., that of the application of knowledge, as discussed above, that S&W's species claim would fail if they incorporated these empirical studies. In other words, empirical studies support the view that knowledge-that possesses plasticity, a key characteristic relating to the application of that type of knowledge. Knowledge-how, at least the sort related to procedural knowledge, does not possess this key characteristic and thus resists the attempt to make it a species of knowledge-that. Thus, S&W's potential attempt to place both knowledge-that and knowledge-how under a single genus would be unsuccessful with regard to the application of knowledge.

Beyond these difficulties that S&W's first potential response would face, their theory is also unable to do the explanatory work in neuroscience that the theory postulating declarative and procedural knowledge as distinct can do. For example, work at the intersection of neuroscience and developmental psychology suggests that much knowledge first begins as procedural knowledge, is later abstracted and then becomes declarative knowledge through a process called "representational redescription" (See Karmiloff-Smith 1992, 1994, p. 694). This view provides a dynamic approach that, rather than focusing only on the learning processes and memory systems of adults, allows development to play a role in theorizing about the functions of different areas of the brain. The theory of "representational redescription" supports the view that, although they are distinct, these memory systems work together. So, it is not the case that S&W's (or Hetherington's) view is falsified by the data from neuroscience and psychology; rather, once S&W grant that these types of knowledge, i.e., procedural and declarative knowledge, are distinct, then their further potential reply (motivated by their *a priori* analysis) that these are *really just two distinct types of knowledge-that* seems not only prevented by a key difference between the two but also useless in doing explanatory work for projects in neuroscience about human learning.

The second way S&W might respond would be to suggest that the data from these studies can be explained by appealing to capabilities. S&W grant that capabilities are distinct from knowledge-that. One example of a capability is digestion.²⁶ These non-intentional actions are distinct from intentional actions, such as riding a bike, the latter of which S&W argue are reliant upon knowledge-that. On this line of response, S&W might argue that the studies mentioned above, for example, the study relating to the skill of reading backwards text in a mirror, could be explained as a mere capability. Like digestion, S&W would argue, the "skill" of mirror-reading is merely a non-intentional capability, and thus the evidence presented above does not threaten their denial of the distinction between knowledge-that and knowledge-how.

There are two primary reasons why the empirical studies above cannot be explained by appealing to capabilities. First, one is unable to improve capabilities with repeated exposure and intentional practice. For example, one cannot digest better than someone else by "practicing" digestion; rather, digestion appears to be a biological process outside of our direct control. It might seem, though, that one *can* improve one's capability to digest, e.g., by eating foods which encourage digestion or by taking a dietary

²⁶ S&W do not use the term 'capability', but they refer to a category of non-intentional actions that are distinct from the actions they seek to explain (cf. 415).

supplement pill designed to help digestion.²⁷ In either case, it seems that there is a difference between intentionally practicing and improving a skill and setting up circumstances or conditions so that a capability such as digestion can function more efficiently. Here is a key difference between the two: when developing a skill such as riding a bike, one improves this skill by repeated, intentional engagement in the activity, but one does not, however, improve one's digestion by digesting repeatedly. The skills involved in the mirror-reading study mentioned above, however, were developed and improved only because the subjects repeatedly directed their attention toward the task at hand.

The example of digestion helps make clear two components that are involved in skill acquisition. First, one intentionally engages in the activity so as to improve one's skill. Second, one may manipulate circumstances or conditions so that one can engage in the activity more efficiently. For example, one may lose weight or take steroids so that one is able to kayak more skillfully. Capabilities and skills share the second component in common, but the first component, i.e., the need to intentionally engage in the activity to improve one's skill, is unique to skills and skill acquisition.

The second reason why the empirical studies above cannot be explained by appealing to capabilities is that the skills involved with procedural knowledge can be combined with declarative knowledge in a way that mere capabilities cannot. The study on the probabilistic task is relevant here (cf. [Reber et al. 1996](#)). In this study, the amnesic subjects acquired the new skill at a rate equal to that of the control group. When asked to abstract principles away from the skill and apply it to a new task, however, the amnesic group was severely limited. This is because they were unable to have procedural and declarative knowledge combine together to apply the skill knowledge they had acquired to new and different contexts. This study supports the traditional characterization of knowledge-how as rigid in application; knowledge-that, however, is characterized by its plasticity. For new skills to have such plasticity, there must be an interplay between knowledge-that and knowledge-how. This connection between the skills presented in these empirical studies and knowledge-that shows a clear difference between knowledge-how and capabilities. Capabilities such as digestion simply do not combine with knowledge-that so that they can be used in other contexts.

In summary, the evidence from the empirical studies referenced in this paper demonstrates that it is possible to both acquire and improve skill knowledge even in the complete absence of declarative knowledge. Likewise, related studies suggest that it is possible to acquire declarative knowledge even when it is difficult to acquire or improve skill knowledge. Strangely, there has been very little mention of these studies in the philosophical literature on the distinction between knowledge-that and knowledge-how.²⁸ Since the theory that posits the double dissociation of declarative and procedural knowledge explains all the phenomena that S&W and Hetherington

²⁷ Thanks to an anonymous reviewer for the first example and to John Dilworth for the second example.

²⁸ I was able to locate only two recent philosophy articles that made mention of this research. See [Sahdra et al. \(2003\)](#) and [Young \(2004\)](#). The former discusses this in the context of skills possessed by biologists, and the latter discusses distinctions of procedural versus non-procedural knowledge so it is not directly related to the topic of the present paper.

are able to explain and, in addition, is best able to explain the phenomena that these two have difficulty explaining, it seems that it provides the best distinction between declarative knowledge (knowledge-that) and procedural knowledge (knowledge-how). Despite Ryle's unsuccessful refutation of intellectualism, it seems his positive argument for the distinction has, in the end, been vindicated by empirical research.

3 Conclusion

In this paper, I have discussed two contemporary views of the distinction between knowledge-that and knowledge-how, and I have offered a preliminary suggestion as to how philosophers might incorporate studies from empirical psychology and neuroscience into the debate. I argue that Ryle made the correct distinction, but I support this claim by appealing to a theory that posits the double dissociation of knowledge-that and knowledge-how.

The evidence I have presented in this paper does not rule out linguistic data as a possible source of evidence in developing a theory of knowledge; rather, my primary contention is that theories of knowledge, as well as the theory of the distinction between knowledge-that and knowledge-how, must be constrained by empirical data on brain systems. Some may contend that including these studies relating to the distinction between procedural and declarative knowledge in a theory of knowledge raises other questions. Many researchers would grant the existence of these two (or sometimes more, cf. fn. 24) brain systems, but granting that there are multiple brain systems brings in a different debate as to how exactly these two systems should be characterized.²⁹ Incorporating this data on multiple brain systems does certainly raise further questions, but answering these would go beyond the scope of this paper.

The primary purpose of this paper has been to establish the relevance and usefulness of the distinction between knowledge-that and knowledge-how in neuroscience and argue that theories in epistemology that reject the distinction fail to explain relevant phenomena relating to knowledge. Furthermore, although there may be debate about what exactly one should call these systems (cf. fn. 29), the data on brain systems encourages a view of at least two systems of memory supporting at least two types of knowledge. Whether or not in the end (e.g., with further research in neuroscience) these multiple systems *directly and completely* map onto the distinction of knowledge-that and knowledge-how used by philosophers, the data collected so far argue strongly against those theories, like S&W's and Hetherington's theory, that attempt to unify all knowledge under one type.

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²⁹ For a detailed discussion of these two memory systems and the names and characterizations surrounding them, see [Sherry and Schacter \(1987\)](#).

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