

1. Introduction

In their delightfully provocative paper, “Knowing How,” Jason Stanley and Timothy Williamson (“S&W”) reject Gilbert Ryle’s thesis (1949; 1971) that “there is a fundamental distinction between knowledge-how and knowledge-that” (2001: 411).¹ Indeed, they seem to regard that widely accepted thesis as nothing but a “philosophical prejudice” (p. 431). They offer an ingenious linguistic argument for the sharply different view that “knowledge-how is simply a species of knowledge-that” (p. 411).

S&W’s argument starts from a claim about the syntax of English *ascriptions* of knowledge-how. Their paradigm ascription is:

(P) Hannah knows how to ride a bicycle. (p. 417)

They claim that ascriptions like (P) contain embedded questions. They go on to argue that, according to the “standardly accepted semantics,” such ascriptions attribute propositional knowledge (p. 420). From this they arrive at their conclusion - since aptly called “Intellectualist” by Stanley (2010) - that knowledge-how is a species of knowledge-that.

Why should we care about knowledge-how? From a naturalistic perspective, we should care only if knowledge-how is a feature of mental reality that is pertinent to psychological explanations. And philosophers have thought that it is, as S&W note. They discuss two “representative cases” (pp. 441-4): David Lewis’ appeal (1990) to knowledge-how in responding to Frank Jackson’s famous “knowledge argument” about Mary; and my appeal (1996) to it in discussing linguistic competence.

I do indeed appeal to it, saying that linguistic competence is mere knowledge-how. However, I have always preferred to say that the competence is simply a skill or ability (1981: 92-110; 1996: 22-8, 52; 1997: 272-5; Devitt and Sterelny 1999: 187-90). Still, I am strongly committed to the competence *not* being knowledge-that. So, if we must follow the folk in talking of linguistic competence as “knowledge” at all, then it looks as if I must accept that the competence is knowledge-how. I think that it would be better if we did not follow the folk in this talk (2006: 5 n. 5), but there is no doubt that it is tempting to do so. So, I clearly have a particular interest in rejecting S&W’s view that knowledge-how entails knowledge-that.

The distinction between knowledge-how and knowledge-that is, of course, a folk psychological one captured in English using the very loose term ‘know’. My take on the distinction has always been along the following rather Rylean lines (Devitt and Sterelny 1989; 1999: 174-5; Devitt 2006: 46-7, 50). Knowledge-that is essentially cognitive and propositional. So if a person knows that R is a rule of arithmetic she knows a proposition. Knowledge-how, in contrast, is in the

¹ All unidentified references are to this work.

same family as skills, abilities and capacities. Sometimes it is entirely cognitive; for example, knowing how to play chess. Other times, it may be hardly cognitive at all; for example, knowing how to swim or ride a bicycle.² Sometimes, knowledge-how may involve knowledge-that; for example, chess know-how may involve knowing that the rules of chess are such and such. Other times it is, as the folk would say, “mere know-how” and *prima facie* does not involve any propositional knowledge at all; for example, knowing how to swim.

Paul Snowdon (2003), and John Bengson, Marc Moffett and Jennifer Wright (2009), have made me think that this account is probably *too* Rylean. There is evidence that the folk count a person who can give a full description of an activity as knowing how to perform it even though the person has no ability to perform it. So, perhaps *one* kind of knowledge-how is knowledge-that. But I still want to maintain that another kind is not. There is a common kind of knowledge-how that a person can have simply on the basis of having the ability to perform an activity:³ the knowledge may be *mere* knowledge-how. That is the kind that Ryle had in mind. If there really is such a kind then, contrary to S&W, not all knowledge-how is knowledge-that.

My paper has two aims. First, to argue that the Intellectualist thesis is false. My argument starts in section 2 by rejecting the alleged intuitive support for the thesis. But the core of my case against Intellectualism comes in sections 3 and 4 from something ignored by S&W, the *science* of knowledge-how. Finally, in section 5, I look critically at S&W’s particular Intellectualist thesis. If my argument against Intellectualism is right then there must be something wrong with the semantic theory that leads S&W to it, but I shall make no serious attempt to say what.⁴ My second aim is to argue that S&W’s methodology of deriving a theory of knowledge-how from a linguistic theory of ascriptions, without any attention at all to the science of knowledge-how, is deeply misguided. That is the concern of the concluding section 6.

2. Intuitions

S&W rightly think that their semantic theory of knowledge-how ascriptions like (P) would gain support if analogous ascriptions were found to ascribe relations between persons and propositions. They claim that analogues “clearly” do ascribe such relations (pp. 419, 422). They offer no reasons independent of their linguistic theory for these claims; the claims seem to rest solely on S&W’s intuitions.⁵ I shall start by considering these intuitions. I do not share them. With almost all the analogues, it is far from clear that they ascribe relations to propositions. And

² As these examples illustrate, the concern here is with knowing how *to A* where *A* is some activity.

³ Bengson *et al* have conducted an experiment that leads them to doubt this (2009: 397). I am not persuaded by the experiment but will not attempt to argue the matter here.

⁴ Ian Rumfitt (2003), however, does make a serious attempt, claiming that the semantics does not hold up when we consider other languages. Thus, although some ascriptions of knowledge-how in French may fit S&W’s analysis, those ascribing knowing how to swim, ride a bicycle, and the like, do not. These ascriptions seem to attribute a relation to an activity not to a proposition, just as those who emphasize the distinction between knowledge-how and knowledge-that would hope. Stanley responds to this and other cross-linguistic challenges in a follow-up paper (2010).

⁵ Snowdon 2003 expresses some similar ones.

with some it seems to me fairly clear that they do *not* ascribe such relations, just as it does that knowledge-how ascriptions do not.

(a) S&W first consider a group of ascriptions that are like (P) but ascribe knowledge-*where*, knowledge-*whom*, knowledge-*which*, or knowledge-*why*; for example, ‘Hannah knows where to find a nickel’ (p. 418). For a person to know why, she must have reasons, and so knowledge-why does indeed seem to be propositional. But what about the others? It is helpful to think of animals. The foraging desert ant wanders all over the place until it finds food and then always heads straight back to its nest (described in Gallistel 1990). On the strength of this competence, we feel no qualms about saying that it “knows where to find its nest.” But to attribute any propositional attitudes to the ant simply on the strength of that competence seems like soft-minded anthropomorphism. Cognitive ethologists might lead us in that direction, of course – on which more in section 4 - but we don’t seem to get knowledge-that *for nothing* with knowledge-where.⁶

(b) S&W next consider ascriptions that are like (P) and the first group except that they are tensed and refer to another person; for example, ‘Hannah knows how Bill rides a bicycle’ (p. 418). Again none of these ascriptions, except the ascription of knowledge-why, seems “*clearly*” to ascribe propositions. Thus mightn’t Hannah demonstrate this knowledge-how *simply* by imitating Bill riding a bicycle? And consider the western scrub jay. One of these, X, may observe another, Y, caching food, and later raid the cache (Clayton *et al* 2006). We are inclined to say that X knows where Y cached the food. Ethologists think that these jays are pretty smart but *must* they say that this knowledge-where is propositional?

(c) Finally S&W consider ascriptions of *learning-how*, *recalling-how*, *asking-how*, *wondering-how*, *being certain-how*, *indicating-how*, and *seeing-how*. Asking-how seems propositional but none of the rest does, certainly not “*clearly*” propositional. Chicks learn how to fly and babies see how to walk. This does not seem like grasping propositions. And the psychological evidence of implicit learning, mentioned briefly in section 4, counts heavily against the view that learning-how must be propositional.

In sum, I suggest that consideration of the analogous ascriptions does not give intuitive support to S&W’s view of knowledge-how. Rather, it suggests that S&W should take another look at their semantic theory.

But all of this is “mere intuition.” I turn now to more serious objections to S&W’s Intellectualism. The most serious of all comes from the psychology of skills.

3. The Psychology of Skills⁷

The folk distinction between knowledge-that and knowledge-how is commonly thought to be the same as the psychological one between “declarative” and “procedural” knowledge. That distinction

⁶ C.f. Stanley’s claim that knowledge-where is “definable” in terms of propositional knowledge (2010).

⁷ I draw on a much more detailed discussion in Devitt 2006, pp. 210-20.

originated in AI but is widely acknowledged, frequently applied, and very important in psychology. Thus, John Anderson, a leading cognitive psychologist, writes:

The distinction between *knowing that* and *knowing how* is fundamental to modern cognitive psychology. In the former, what is known is called *declarative knowledge*; in the latter, what is known is called *procedural knowledge*. (1980: 223)

Psychologists describe the distinction, rather inadequately, along the following lines: where declarative knowledge is explicit, accessible to consciousness, and conceptual, procedural knowledge is implicit, inaccessible to consciousness, and subconceptual. Although declarative knowledge may play a role in learning a skill, there is a consensus that the skill itself is a piece of procedural knowledge.

This psychologists' distinction is related to two others. First, there is a distinction between explicit (or declarative) and implicit (or procedural) *memory*. Declarative knowledge involves explicit memory, procedural knowledge involves implicit memory. Explicit memory holds factual knowledge such as that Washington is the capital of America, while implicit memory holds rules that govern processes, "routinized skills,...priming, and classical and operant conditioning" (Bjorklund *et al* 2003: 1059). Second, there is a distinction between explicit and implicit *learning*. Explicit learning is a "top-down" process that starts from declarative knowledge. Consider, for example, learning to change gears in a stick-shift car by starting with instructions like: "First, take your foot off the accelerator, then disengage the clutch." In contrast, implicit learning is a "bottom-up" process: we observe, practice, and "just pick the skill up." A. S. Reber defines implicit learning as follows: "the capacity to pick up information about complex stimulus displays largely without awareness of either the process or the products of learning" (2003: 486). She notes that systems of implicit learning "are rather easily simulated by connectionist architectures" (2003: 487). There is much evidence that a lot of skill learning is implicit; see, for example, the evidence cited by Sun *et al* (2001) that "individuals may learn complex skills without first obtaining a large amount of explicit declarative knowledge... and without being able to verbalize the rules they use" (p. 207).

What is declarative knowledge? The key thing to note for our purposes is that there is a consensus in psychology that it involves a *conscious representation* of what is known. Thus, psychologists think that a subject has declarative knowledge of the processing rules for a task only if she consciously represents the rules. So the person who has declarative knowledge that R is a rule of arithmetic must represent that fact in her central processor. So, if we adopt the popular, and in my view correct, representational theory of the mind ("RTM"), declarative knowledge can indeed be identified with the folk's knowledge-that.

Before considering the nature of procedural knowledge, it is helpful to mention another distinction that I have emphasized elsewhere (2006: 45-52). It comes largely from computer science. It is the distinction between processing rules that govern by being represented and applied and those that govern by being simply embodied without being represented. This is a distinction between two ways in which certain processing rules might be real in an object, two ways in which the rules might be embodied in it. Neither of these ways should be confused with a situation where

an object simply behaves *as if* it is governed by those processing rules. For that situation is compatible with those rules *not* being embodied in the object at all.

A simple old-fashioned mechanical calculator provides a nice example of something governed by rules that are embodied without being represented. When the calculator adds it goes through a mechanical process that is governed by the rules of an algorithm for addition. But the rules are “hardwired” not represented in the calculator. In contrast, the operations of a contemporary general-purpose computer are partly governed by rules of a program that are represented in its RAM and applied. Yet those rules can govern the operations of the computer only because there are other rules that are unrepresented but built into its hardware that enable the represented rules to govern. And, note an important generalization: any processing rule that governs the behavior of one object by being represented and applied could govern that of another by being embodied without being represented.

What is procedural knowledge and hence what are skills? It is agreed that this knowledge is *not* declarative but, beyond that, we have a long way to go in answering this question (Schacter 1999: 395; Sun 2003: 698). The psychological literature reveals a range of interesting ideas but no rational basis at this time for a sweeping acceptance or rejection of the ideas of one or other theoretical camp. What about the representation of rules? It would be nice if procedural knowledge consisted in embodied but unrepresented rules of the sort just mentioned. That would yield the desired sharp distinction between procedural and declarative knowledge of rules. Certainly, there is no persuasive evidence that skills *do* involve representations of the governing rules. But neither is there decisive evidence that the skills *do not* involve these representations. Still, the literature on motor skills,⁸ on dynamical systems theories,⁹ on the Gibson-inspired ecological theories,¹⁰ on connectionist theories,¹¹ on instance theories,¹² on implicit learning,¹³ and on the implementation of skills¹⁴ counts heavily against the idea that skills do involve those representations. The only support for that idea may come from production-systems theories which seem committed to representations of rules in procedural knowledge, albeit representations of a different sort from those involved in declarative knowledge.¹⁵ But, I argue, there are reasons for doubting the appropriateness of this apparent commitment (2006: 215-17).

In sum, the psychological distinction between declarative and procedural knowledge, and the related distinctions about memory and learning, are well established in empirical science. As one researcher says, the evidence for them “lies in experimental data that elucidate various

⁸ See, e.g., Brown and Rosenbaum 2003; Mon-Williams *et al* 2003; Wolpert and Ghahramani 2003.

⁹ See, e.g., Kelso 1995; van Gelder 1999; Garson 2003; Carlson 2003.

¹⁰ See, e.g., Fowler and Turvey 1978; Kugler and Turvey 1987; Newell 1996.

¹¹ See, e.g., Rumelhart and McClelland 1986; Masson 1990; Sun *et al* 2001.

¹² See, e.g., Logan 1988.

¹³ See, e.g., Mathews *et al* 1988, 1989; Reber 1989, 2003; Stanley *et al* 1989; Sun *et al* 2001; Cleeremans 2003.

¹⁴ See, e.g., Yamadori *et al* 1996; Posner *et al* 1997.

¹⁵ See, e.g., Anderson 1983, 1993; Laird *et al* 1987; Singley and Anderson 1989; Anderson and Lebiere 1998; Masson 1990; Lebiere 2003; Jones 2003.

dissociations and differences in performance under different conditions” (Sun 2003: 698).¹⁶ And all of this is evidence for the nature of, near enough, the folk distinction between knowledge-that and knowledge-how.

I say “near enough” because I think that the psychologists would have done better to identify their procedural knowledge with one common kind of the folk’s knowledge-how, *mere* knowledge-how. For, as we noted (sec. 1), it is that Rylean kind of knowledge-how that is thought not to involve knowledge-that. Still, we needn’t fuss about this: mere knowledge-how is still knowledge-how. So, if the psychologists are right and procedural knowledge does not involve declarative knowledge, then declarative knowledge is not essential to knowledge-how.

This psychology is very bad news for S&W. Knowledge-that is declarative knowledge. So, psychology shows that procedural knowledge, hence knowledge-how, does not require knowledge-that, precisely what S&W’s Intellectualism claims it does require. Despite disagreement or uncertainty on many other issues, psychologists speak with one voice on this one. Even production-system theories, which seem to posit representations of processing rules and hence seem to have the most “intellectualized” picture of procedural knowledge, distinguish this knowledge sharply from declarative knowledge. Psychology presents a picture of procedural knowledge as constituted somehow or other by embodied, probably unrepresented, rules that are inaccessible to consciousness. It is thus quite different from declarative knowledge which consists of representations that are available to consciousness.

4. Cognitive Ethology

The distinction between procedural and declarative knowledge is also central to cognitive ethology: “Declarative knowledge is ‘knowing that’ whereas procedural knowledge is ‘knowing how,’ or knowing what to do, as in a stimulus-response connection” (Shettleworth 1998: 5; see also McFarland 1991). It is obvious that animals, from insects to primates, have a vast range of skills, many of them innate.¹⁷ The very difficult challenge in explaining the nature of each of these skills is to find the right place between a “rash anthropomorphism” that attributes declarative knowledge to the organism on little evidence, and a crass behaviorism that implausibly attributes only the simplest forms of procedural knowledge (Burghardt 1985: 905). Ethologists (and comparative psychologists) take up this challenge by seeking evidence that forces them away from strictly behaviorist explanations. And they have found plenty, leading them to posit surprisingly rich cognitive lives; for example, evidence in navigation by insects (described in Gallistel 1990), in caching strategies by western scrub jays (Clayton *et al* 2006), and in language learning by bottlenosed dolphins (Herman 2002, 2006). But I see no sign in the literature of retreat from the received view that procedural knowledge is quite distinct from declarative knowledge.

At one point S&W briefly consider an objection that arises from considering animals:

¹⁶See also Schacter 1999 (p. 394), the many results cited by Sun *et al* 2001 (p. 207), Cleeremans 2003 (p. 492), Mulligan 2003 (pp. 1115-7), Reber 2003 (p. 491).

¹⁷Sometimes, the term ‘skill’ is restricted to something learnt (Carlson 2003: 36). This is not wise verbal legislation. Something with the nature of a skill that is, as a matter of fact, learnt, could, in another possible world, be innate. We need a theory of that nature whatever its source.

in certain situations, we smoothly ascribe knowledge-how to animals....One might think that non-human animals are not sufficiently conceptually sophisticated enough to possess propositional knowledge. But this objection is a non-starter. For in similar scenarios, we just as smoothly ascribe propositional knowledge to non-human animals. (pp. 438-9)¹⁸

This swift response will not do. Cognitive ethologists and comparative psychologists do indeed ascribe *some* propositional attitudes to *some* animals but they are mighty cautious about doing so.¹⁹ They are not similarly cautious about ascribing knowledge-how. Indeed, it is simply taken for granted that non-human animals have a great deal of knowledge-how or procedural knowledge: “there seems little doubt that nonhuman animals have varying degrees of procedural knowledge” (Shank 2002: 211). Even traditional ethologists and behavioral scientists accept that they have. And why wouldn’t they since the results of conditioned and associative learning count as procedural knowledge?

An explanation of how an animal *knows how* might simply involve a stimulus-response connection or the fruit of some other form of associative learning, or it might involve the attribution of something more complex, such as the internal representation of the external environment – a cognitive map of the world in which it lives. (*ibid*)

So there is no caution about saying, for example, that the earlier-mentioned ant knows how to get to the nest,²⁰ and the earlier-mentioned jay knows how to raid a cache; about saying that a honey bee knows how to communicate the direction and distance of a food source using a “waggle dance”; and so on through much of the behavior of animals. Yet I doubt that S&W could find a single ethologist or psychologist who would be prepared to ascribe to these animals, particularly to insects, the propositional knowledge that – we shall see in the next section - S&W’s account of knowledge-how requires.²¹

In sum, a nonpropositional view of knowledge-how is not just philosophical prejudice or even just folk theory: it seems to be entrenched in psychology and cognitive ethology. We have very good reasons to suppose that there are nonpropositional states of knowledge-how, constituted probably by embodied but unrepresented rules, states that are central to explaining many behaviors. Could *any* semantic theory be strong enough to overthrow this? I think that is most unlikely. I love some semantic theories myself but I don’t think that any one of them is well-enough established to have this metaphysical clout. S&W’s semantic theory must be mistaken.

Perhaps not. In supposing that S&W’s semantics of knowledge-how ascriptions is inconsistent with the psychology of procedural knowledge I am presuming that these ascriptions

¹⁸ Consider the following also: “In those cases where attributions of know-how are scientifically indispensable, we are comfortable with the corresponding attributions of propositional knowledge...” (Bengson *et al*: 399).

¹⁹ See Burghardt 1985, Shettleworth 1998, and Heinrich 2002 for helpful discussions.

²⁰ On the role of procedural knowledge in ant navigation, see Knaden *et al* 2006.

²¹ Thanks to Colin Allen and Robert Lurz for advice on this paragraph.

sometimes *succeed* in describing the reality of procedural knowledge. But perhaps they never do succeed. Perhaps, S&W should be seen not as challenging psychological theories of procedural knowledge but only the view that this knowledge is ever knowledge-how, that it is a kind of knowledge-how. So S&W have shown us that the procedural knowledge that psychologists and ethologists think of as knowledge-how, and much of which the folk would also surely think of as knowledge-how, is not really knowledge-how. That would be a bold claim indeed to rest on a semantic theory.

These last two sections have presented the main case against S&W's Intellectualism. In the next section I will add a little to this case by looking at the details of their view.

5. Stanley and Williamson's Intellectualism

S&W's view that all knowledge-how is knowledge-that is not only at odds with psychology and ethology, it is highly implausible. Stephen Schiffer has given a brief but neat demonstration of this with his examples of the young Mozart and Clyde the chicken-sexer (2002). I shall attempt to add to Schiffer's case.

Consider what S&W tell us about their paradigm: (P) "is true relative to a context *c* if and only if there is some contextually relevant way *w* such that Hannah stands in the knowledge-that relation to the Russellian proposition that *w* is a way for Hannah to ride a bicycle, and Hannah entertains this proposition under a practical mode of presentation" (2001: 430). Schiffer notes that "we are not given the slightest clue as to what 'practical modes of presentation' are like" (2002: 201). Set that aside. According to S&W, for (P) to be true Hannah has to have the thought that *w* is a way for Hannah to ride a bicycle. This requires, of course, that Hannah has the *general* concept of ways of riding a bicycle, which she may well have. But it also requires that she has a *singular* concept that *identifies* a type of action *w* which is, as a matter of fact, a way of riding a bicycle. Is it plausible that she, indeed *every* bicycle rider, has identified such an action? S&W claim, reasonably enough, that this identification need not be descriptive, it can be indexical (2001: 433). But how plausible is it that riders even have an indexical concept of such an action?

Take a favorite example of mine (2006: 50). Outfielders in professional baseball know how to catch fly balls. An essential part of this is being at the right place when the ball descends to catch height. An experiment showed that skilled fielders "ran at a speed that kept the acceleration of the tangent of the angle of elevation of gaze to the ball at 0" (McLeod and Dienes 1996: 531). So, according to S&W, fielders have a singular concept of this type of movement. Fielders don't have to think of the movement in those terms, of course, but they still have to have identified it. It does not seem plausible that all fielders can manage this.

It gets worse. Some people know how to think rationally. According to S&W they must have a singular concept that identifies something that is, as a matter of fact, a way of thinking rationally. Does *anyone* have such a concept? And *must* everyone who thinks rationally have the general concept of thinking rationally, or even the concept of thinking?

Let us apply S&W's view to the case of linguistic knowledge. Hannah knows how to speak a language *L*. So, she knows how to use a sound of *L* to express a thought with the meaning

that the sound has in *L* in the context of utterance. Once again, does *anyone* have a singular concept of something that is a way of doing this? Must *everyone* who can do it have the sophisticated general concept of a way of doing it? To suppose so is to fly in the face of developmental evidence that the capacity to think about one's language does not normally come until middle childhood, well after linguistic competence.²² So, it is very likely that Hannah, in early childhood, did not even have the concept of *L* and so *could not* have had the sophisticated concept. Yet she already knew how to speak *L*.

This concludes my case against S&W's Intellectualism. I turn finally to their methodology.

6. Methodology

On the basis of assumptions about linguistic expressions that concern the psychological world, without any attention to the science of that world, S&W draw a very bold conclusion about the nature of that world. I think that we should always be suspicious of this way of proceeding: our semantic theories should be guided by our theories of the world rather than vice versa. We should follow the methodology of "putting metaphysics first."

Why? Because we know much more about the way the world is than we do about the semantics of our talk about that world. I have argued for this, and the methodology it supports, in the course of arguing against the linguistic turn in contemporary philosophy. Similarly, I have argued that we should reject the epistemological turn in modern philosophy because we know much more about the way the world is than we do about how we know about that world. We should approach epistemology and semantics from a metaphysical perspective rather than vice versa. My argument for this position reflects a somewhat Moorean approach. More importantly, it reflects Quinean naturalism: the metaphysics I want to put first is a naturalized one (1996, 1997, 2009).

Modern philosophy starts its arguments with what seem to be a priori reflections on epistemology. Contemporary philosophy starts its arguments with what seem to be a priori reflections on semantics. S&W's starting point is importantly different: contemporary linguistics. This move to empirical science is a great improvement. Still, their argument proceeds in the wrong direction. Contemporary linguistics is undoubtedly successful but it is most unlikely that it could refute any well-established view about the nature of the nonlinguistic world, any well-established "metaphysical" views. The view of knowledge-how that S&W claim to refute is, we have seen, such a view.

S&W are not at all bashful about proceeding from linguistics to psychology (see, e.g., p. 431). Furthermore they are critical of the methodology of their opponents: "Surprisingly...none of Ryle's followers has ever given an explicit syntax and semantics for [ascriptions of knowledge-how], much less one which would give them the interpretations they claim such constructions to have" (p.432). But there is nothing surprising about this at all! Scientists have

²² See particularly, Hakes 1980, Ryan and Ledger 1984, Bialystok and Ryan 1985, Bialystok 1986, Schütze 1996.

typically, perhaps even always, described their domains with little attention to the syntax and semantics of the descriptions they use for this purpose. Why should psychology, whether folk or scientific, be any different? And it is just as well that science has proceeded in this way else we would have had very little of it. For, only recently have we had powerful syntactic theories. And semantic theories are still in their infancy. The real surprise in this debate is provided by S&W themselves. For, they offer a theory of knowledge-how on the basis of linguistics without any attention at all to the science of knowledge-how. Linguistics is surely wonderful but it can't cure wooden legs.

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REFERENCES

- Anderson, John R. 1980. *Cognitive Psychology and its Implications*. San Francisco: W. H. Freeman and Company.
- _____. 1983. *The Architecture of Cognition*. Cambridge, MA: Harvard University Press.
- _____. 1993. *Rules of the Mind*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- _____, and Christian Lebiere. 1998. *The Atomic Components of Thought*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Bekoff, Marc, Colin Allen, and Gordon M. Burghardt, eds. 2002. *The Cognitive Animal: Empirical and Theoretical Perspectives on Animal Cognition*. Cambridge, MA: MIT Press.
- Bengson, John, Marc A. Moffett, and Jennifer C. Wright. 2009. "The Folk on Knowing How." *Philosophical Studies* 142: 387-401.
- Bialystok, Ellen. 1986. "Factors in the Growth of Linguistic Awareness." *Child Development* 57: 498-510.
- _____, and Ellen Bouchard Ryan. 1985. "A Metacognitive Framework for the Development of First and Second Language Skills." In *Metacognition, Cognition, and Human Performance*, D. L. Forrest-Pressley, G. E. MacKinnon, and T. G. Waller, eds. New York: Academic Press: 207-52.
- Bjorklund, David F., Wolfgang Sneider, and Carlos Hernandez Blasi. 2003. "Memory." In Nadel 2003, vol. 2: 1059-65.
- Brown, Liana E., and David A. Rosenbaum. 2003. "Motor Control: Models." In Nadel 2003, vol. 3: 127-33.
- Burghardt, Gordon M. 1985. "Animal Awareness: Current Perspectives and Historical Perspectives." *American Psychologist* 40: 905-19.
- Carlson, Richard A. 2003. "Skill Learning." In Nadel 2003, vol. 4: 36-42.
- Clayton, Nicola, Nathan Emery, and Anthony Dickinson. 2006. "The Rationality of Animal Memory: Complex Caching Strategies of Western Scrub Jays." In Hurley and Nudds 2006: 197-216.
- Cleeremans, Axel. 2003. "Implicit Learning Models." In Nadel 2003, vol. 2: 491-9.
- Devitt, Michael. 1981. *Designation*. New York: Columbia University Press.
- _____. 1996. *Coming to Our Senses*. Cambridge: Cambridge University Press.
- _____. 1997. *Realism and Truth*. 2nd edn with new afterword. (1st edn 1984.) Princeton: Princeton University Press.
- _____. 2006. *Ignorance of Language*. Oxford: Clarendon Press.

- _____. 2010. *Putting Metaphysics First: Essays on Metaphysics and Epistemology*. Oxford: Oxford University Press.
- _____, and Kim Sterelny. 1989. "What's Wrong with 'the Right View'." In *Philosophical Perspectives, 3: Philosophy of Mind and Action Theory, 1989*, ed. James E. Tomberlin. Atascadero: Ridgeview Publishing Company, 497-531.
- _____. 1999. *Language and Reality: An Introduction to the Philosophy of Language*, 2nd edn. 1st edn 1987. Cambridge, MA: MIT Press.
- Downing, John, and Renate Valtin, eds. 1984. *Language Awareness and Learning to Read*. Berlin: Springer Verlag.
- Fowler, C. A., and M. T. Turvey. 1978. "Skill Acquisition: An Event Approach with Special Reference to Searching for the Optimum of a Function of Several Variables." In *Information Processing and Motor Control*, G. E. Stelmach, ed. New York: Academic Press.
- Gallistel, C. R. 1990. *The Organization of Learning*. Cambridge, MA: MIT Press.
- Garson, James. 2003. "Dynamical Systems, Philosophical Issues about." In Nadel 2003, vol. 1: 1033-9.
- Hakes, David T. 1980. *The Development of Metalinguistic Abilities in Children*. Berlin: Springer-Verlag.
- Heinrich, Bernd. 2002. "Raven Consciousness." In Bekoff *et al* 2002: 47-52.
- Herman, Louis M. 2002. "Exploring the Cognitive World of the Bottlenosed Dolphin." In Bekoff *et al* 2002: 275-83.
- _____. 2006. "Intelligence and Rational Behavior in the Bottlenosed Dolphin" In Hurley and Nudds 2006: 439-67.
- Hurley, Susan, and Matthew Nudds, eds. 2006. *Rational Animals*. Oxford: Oxford University Press.
- Jones, Gary. 2003. "Production Systems and Rule-Based Inference." In Nadel 2003, vol. 3: 741-7.
- Kelso, J. A. Scott. 1995. *Dynamic Patterns: The Self-Organization of Brain and Behavior*. Cambridge MA: MIT Press.
- Knaden, Markus, Christina Lange, and Rüdiger Wehner. 2006. "The Importance of Procedural Knowledge in Desert-ant Navigation." *Current Biology* 16: R916-R917.
- Kugler, P.N., and M. T. Turvey. 1987. *Information, Natural Laws, and the Self-Assembly of rhythmic Movement*. Hillsdale, NJ: Laurence Erlbaum.
- Laird, J. E., A. Newell, and P. S. Rosenbloom. 1987. "Soar: An Architect for General Intelligence." *Artificial Intelligence* 33: 1-64.
- Lebiere, Christain. 2003. "ACT." In Nadel 2003, vol. 1: 8-14.
- Lewis, David. 1990. "What Experience Teaches." In *Mind and Cognition* ed. William G. Lycan. Cambridge, MA: Blackwell: 499-519.
- Logan, Gordon D. 1988. "Toward an Instance Theory of Automatization." *Psychological Review* 95: 492-527.
- McFarland, D. 1991. "Defining Motivation and Cognition in Animals." *International Studies of Philosophy of Science*, 5, 153-170.
- McLeod, Peter, and Zoltan Dienes. 1996. "Do Fielders Know Where to Go to Catch the Ball or Only How to Get There?" *Journal of Experimental Psychology: Human Perception and Performance* 22: 531-43.
- Masson, Michael E. J. 1990. "Cognitive Theories of Skill Acquisition." *Human Movement Science* 9: 221-39.
- Mathews, R. C., R. R. Buss, W. B. Stanley, and R. Chinn. 1988. "Analysis of Individual Learning Curves in a Concept Discovery Task: Relations among Task Performance, Verbalizable

- Knowledge, and Hypothesis Revision Strategies.” *The Quarterly Journal of Experimental Psychology* 40A: 135-65.
- Mathews, R. C., R. R. Buss, W. B. Stanley, F. Blanchard-Fields, J. R. Cho, and B. Druhan. 1989. “Role of Implicit and Explicit Processes in Learning From Examples: A Synergistic Effect.” *Journal of Experimental Psychology: Learning, Memory, and Cognition* 15: 1083-100.
- Mon-Williams, Mark, James R. Tresilian, and John P. Wann. 2003. “Motor Control and Learning.” In Nadel 2003: 121-6.
- Mulligan, Neil W. 2003. “Memory: Implicit versus Explicit.” In Nadel 2003, vol. 2: 1114-20.
- Nadel, Lynn, ed. 2003. *Encyclopedia of Cognitive Science*. London: Nature Publishing Group.
- Newell, Karl M. 1996. “Motor Skills.” In *Encyclopedia of Learning and Memory*, ed. Larry R. Squire. Macmillan Library Reference: 441-3.
- Posner, M. I., G. J. DiGirolamo, and D. Fernandez-Duque. 1997. “Brain Mechanisms of Cognitive Skills.” *Consciousness and Cognition* 6: 267-90.
- Reber, A. S. 1989. “Implicit Learning and Tacit Knowledge.” *Journal of Experimental Psychology: General* 118: 219-35.
- _____. 2003. “Implicit Learning.” In Nadel 2003, vol. 2: 486-91.
- Rumelhart, D. E., and J. L. McClelland. 1986. *Parallel Distributed Processing: Explorations in the Microstructure of Cognition, vol. 1, Foundations*. Cambridge, MA: MIT Press.
- Rumfitt, Ian. 2003. “Savoir Faire.” *Journal of Philosophy* 100: 158-66.
- Ryan, Ellen Bouchard, and George W. Ledger. 1984. “Learning to Attend to Sentence Structure: Links Between Metalinguistic Development and Reading.” In Downing and Valtin 1984####: 149-71
- Ryle, Gilbert. 1949. *The Concept of Mind*. Chicago: Chicago University Press.
- _____. 1971. “Knowing How and Knowing That.” In *Gilbert Ryle: Collected Papers*, vol. 2. New York: Barnes and Noble: 212-225.
- Schacter, Daniel L. 1999. “Implicit vs Explicit Memory.” In Wilson and Keil 1999: 394-5.
- Schiffer, Stephen. 2002. “Amazing Knowledge.” *Journal of Philosophy* XCIX: 200-2
- Schütze, Carson T. 1996. *The Empirical Base of Linguistics: Grammaticality Judgments and Linguistic Methodology*. Chicago: University of Chicago Press.
- Shank, Niall. 2002. *Animals and Science: A Guide to the Debates*. Santa Barbara, CA: ABC-CLIO.
- Shettleworth, Sara J. 1998. *Cognition, Evolution, and Behavior*. New York: Oxford University Press.
- Singley, Mark K., and John R. Anderson. 1989. *The Transfer of Cognitive Skill*. Cambridge MA: Harvard University Press.
- Snowdon, Paul. 2003. “Knowing How and Knowing That: A Distinction Reconsidered.” *Proceedings of the Aristotelian Society* 104: 1-29.
- Stanley, Jason. 2010. “Knowing (How).” *Nous*, forthcoming
- _____, and Timothy Williamson. 2001. “Knowing How.” *Journal of Philosophy* 98: 411-44.
- Stanley, William B., Robert C. Mathews, Ray R. Buss, and Susan Kotler-Cope. 1989. “Insight Without Awareness: On the Interaction of Verbalization, Instruction and Practice in a Simulated Process Control Task.” *The Quarterly Journal of Experimental Psychology* 41A: 553-77.
- Sun, Ron. 2003. “Connectionist Implementationalism and Hybrid Systems.” In Nadel 2003, vol. 1: 697-703.

- _____, Edward Merrill, and Todd Peterson. 2001. "From Implicit Skills to Explicit Knowledge: A Bottom-Up Model of Skill Learning." *Cognitive Science* 25: 203-44.
- Van Gelder, Tim. 1999. "Dynamic Approaches to Cognition." In Wilson and Keil 1999: 244-6.
- Wilson, Robert A., and Frank C. Keil, eds. 1999. *The MIT Encyclopedia of the Cognitive Sciences*. Cambridge, MA: MIT Press.
- Wolpert, Daniel M., and Zoubin Ghahramani. 2003. "Motor Learning Models." In Nadel 2003, vol. 3: 138-42.
- Yamadori, Atsushi, Takashi Yoshida, Etsuro Mori, and Hikari Yamashita. 1996. "Neurological Basis of skill learning." *Cognitive Brain Research* 5: 39-54.