Biology and Philosophy (2005) 20:791–814
DOI 10.1007/s10539-004-6835-7

Innate ideas as a naturalistic source of metaphysical knowledge

STEVE STEWART-WILLIAMS

Department of Psychology, McMaster University, 1280 Main Street West, Hamilton, Ontario, Canada L8S 4K1; (e-mail: anonymous@xtra.co.nz; phone: +1-905-525-9140; fax: +1-905-529-6225)

Received 9 January 2004; accepted in revised form 26 November 2004

Key words: Evolutionary epistemology, Evolutionary psychology, Innate ideas, Justification, Metaphysics, Naturalism, Rationalism

Abstract. This article starts from the assumption that there are various innate contributions to our view of the world and explores the epistemological implications that follow from this. Specifically, it explores the idea that if certain components of our worldview have an evolutionary origin, this implies that these aspects accurately depict the world. The simple version of the argument for this conclusion is that if an aspect of mind is innate, it must be useful, and the most parsimonious explanation for its usefulness is that it accurately depicts the world. There are a number of important criticisms of this argument. These include the idea that evolutionary justifications are circular, that evolved mental content and principles are not necessarily accurate, and that, if the argument is taken seriously, it has some highly dubious consequences. These criticisms necessitate various qualifications to the initial argument. Nonetheless, it is argued that, in some cases, important conclusions can be drawn about the world from an analysis of evolved contributions to our view of the world. An evolutionary approach cannot provide an ultimate justification for any belief; however, in certain circumstances, it supports the conclusion that a given belief is a reasonable first approximation. To the extent that innate content and principles pertain to topics in metaphysics, they can be viewed as a naturalistic source of metaphysical knowledge.

Introduction

> Origins of man now proved. Metaphysics must flourish. He who understands baboon would do more toward metaphysics than Locke. (Darwin 1987: D26, M84)]

> Our instruments of knowledge – our senses, our brains, our linguistic abilities – were not put in place in order to give us a disinterested picture of reality, but to help us to survive and reproduce. (Ruse 1990, p. 105)

The subject matter of this article is captured by the following questions: Does the fact that certain tendencies of belief have an evolutionary origin provide any reason to think that these beliefs are accurate? Can evolutionary theory provide a solution to the problem of induction or justify belief in an

external world or in other minds? Can innate mental content and principles related to such metaphysical topics as causation, space, and time tell us anything about these topics? In short, do 'innate ideas' constitute a naturalistic source of metaphysical knowledge? If I had to answer either 'yes' or 'no' to these questions, and was allowed to say no more, I would be tempted to answer 'no'. This would possibly be closer to the truth than the affirmative response. In the following pages, however, I will aim at a more nuanced answer, an answer that, although perhaps closer to the negative than the affirmative, does allow some tentative metaphysical conclusions to be drawn from innate mental content and principles.

The article begins with an outline of the argument that evolved innate ideas constitute a source of knowledge, following which I consider some of the major criticisms of this argument. In the course of this analysis, I attempt something that, in light of these important criticisms, might seem somewhat foolhardy: I mount a defence of the notion that, in certain circumstances, it is possible to derive knowledge from the fact that certain tendencies of belief have an innate basis. Criteria are provided for judging when it is appropriate to argue from innateness to approximate truth. The overall conclusion is that evolutionary theory cannot provide an ultimate justification for any belief, but that in certain cases, the theory can bolster our conviction that a given belief is a reasonable first approximation. Furthermore, an evolutionary perspective helps judge when appeals to intuition are justifiable and when they are not, helps set appropriate standards of evidence for different philosophical positions, and helps set the agenda for philosophy.

Before going any further, several points are worth clarifying. The first is an issue of terminology, specifically, the meaning of the phrase 'innate ideas'. The debate over innate ideas originally centred on the question of whether certain aspects of mental content (in particular, concepts and beliefs) are innate. However, the debate subsequently divided into two separate questions: whether there is any innate mental content (as opposed to innate content-free processing abilities), and whether there are any innate domain-specific mechanisms (as opposed to innate general-purpose mechanisms). Discussions of innate ideas commonly focus both on beliefs and on belief-producing mechanisms (although unfortunately, the distinction is not always made explicit). To maintain continuity with the earlier discussion, I adhere to the same convention and include within my purview concepts (e.g., *cause* and *object)*, beliefs (e.g., belief in a mind-independent external world), and belief-producing mechanisms (e.g., faculties of causal reasoning, inductive reasoning, and reasoning about minds). The second matter to clarify concerns the justification of claims to innateness. For the purposes of this article, I simply assume without comment that certain concepts, beliefs, and mechanisms have an evolutionary origin. Although some evidence is supportive of this view, the issue is by no means settled. Therefore, the ultimate worth of this article is inevitably linked with the outcomes of subsequent research regarding the evolutionary origin of the aspects of mind in question.

Evolutionary theory and the justification of knowledge

According to Descartes (1641/1986), innate ideas were implanted in the mind by God and must be accurate for God would not deceive. The question under examination here is whether a similar argument can be derived from evolutionary theory, by substituting natural selection for God. That is, if we accept that a given example of innate mental content is a product of natural selection, do we then have any assurance that it is accurate? And if we accept that a given belief-producing mechanism is a product of natural selection, do we then have any assurance that the general principles underlying this mechanism are accurate? Some evolutionary epistemologists have suggested that we do (e.g., Derksen 1993). The general position is captured in the dictum: 'Natural selection would not have left us with eyes that regularly misled us' (Campbell 1987, p. 151).

My first sketch of the evolutionary argument (EA) is as follows (as you notice some of its weaknesses, I would ask for your patience – qualifications are provided later): Any innate mental content or principles are likely to be the product of natural selection. If innate contributions to our representation of the world were not accurate, they would not have been useful and would not have been selected. The fact that they *were* selected gives us some assurance that they are accurate depictions of the world. It indicates that they cannot be too radically mistaken, at least not in any biologically relevant way. The empiricists and logical positivists argued that only concepts that had their origin in experience could be considered meaningful (Hume 1739/1978; Carnap 1967). However, from an evolutionary psychological perspective, our beliefs are not shaped solely by *sensory* experience. They are also shaped by the 'experience' that constitutes the evolutionary history of the species, via certain innate tendencies of the mind. These innate contributions can be viewed as a naturalistic source of knowledge, alongside the evidence of the senses. There is no reason to think that the evidence of the senses is necessarily any more accurate than that of any innate contributions. Both are means by which information can be encoded in the nervous system. Therefore, innate mental content and principles can be viewed as a naturalistic source of knowledge. Some of this content pertains to topics in metaphysics, including metaphysical realism, the existence of other minds, causation, space, and time (Stewart-Williams 2003, 2004; Stewart-Williams and Podd, in press). Where this is the case, and assuming the validity of the EA, this content constitutes a naturalistic source of metaphysical knowledge.

If this argument is accepted, it has some important consequences. First, the EA provides an answer to the radical sceptic or solipsist, who denies the existence of an external world. There is some reason to believe that the belief in an objective, mind-independent external world traces to innate aspects of mind (Stewart-Williams 2003). Nothing in our sensory experience contains the idea that there is a mind-independent external world; all that we experience are fleeting and fragmented sensory impressions. But our minds go beyond the evidence, and interpret these impressions as signs of a stable external world.

The idea of a mind-independent world is not derived from sensory experience. Instead, it must be a consequence of the innate design of our minds. The fact that any normal mind automatically assumes an objective and mind-independent external world may count as proof that such a world does exist. We evolved a mind/brain that creates a sense of an objective, mind-independent external world because this tendency generally contributed to the persistence of the genetic material that gave rise to the tendency. In what kind of world would this tendency be biologically advantageous? It would be advantageous in a world that genuinely exists beyond our fleeting sensory impressions. The fact that this tendency evolved indicates that it was useful, and the simplest explanation for its usefulness is that it is accurate.

The capacity for inductive reasoning provides another example. According to Kornblith (1993), inductive reasoning is a native inferential tendency, and is efficacious because the structure of our minds dovetails with the structure of the reality of which our minds are a part. His view is that 'our inductive inferences are tailored to the causal structure of the world' (p. 91). The strongest conclusion that might be drawn here is that an evolutionary justification of inductive reasoning solves Hume's problem of induction. If induction did not generally work, the capacity for inductive inference would not have evolved; it has and therefore it does. A similar argument can be constructed for abductive inference (Carruthers 1992).

Many other examples can be provided. Stewart-Williams and Hill (article submitted for publication) argued that the capacity for causal cognition is a product of natural selection. If causal cognition does indeed have an evolutionary origin, this would argue for the utility of this tendency and therefore its accuracy. Similarly, it has been argued that the capacity to construe other people as possessing minds (a capacity known as 'theory of mind') has an evolutionary origin (Baron-Cohen 1995; Stewart-Williams and Podd, in press). If this were the case, it would argue that the capacity was useful, and its usefulness would in turn argue that it is related to the reality it aims to represent. Thus, an evolutionary perspective provides a solution to the long-standing philosophical problem of justifying a belief in other minds. Furthermore, this perspective may have implications for the question of consciousness in non-human animals. It has been suggested that theory of mind was selected not only for understanding other humans but also for understanding some non-human animals, including predators and prey (Mithen 1996). If attributing mind, beliefs, and desires to non-humans – in particular closely related ones – was useful in our evolutionary history, then this provides some reason to think that the assumption that non-humans possess such states is accurate. A final example concerns our understanding of space and time. As Hahlweg and Hooker (1989a) noted, if 'an organism was endowed with a space–time framework which did not lead to a sufficiently truthful representation of the environment, then this organism would not survive and would leave no offspring' (p. 28). Ergo, our survival argues for the accuracy of our mental representations of space and time.

It is important to emphasize that, although the EA applies to any innate beliefs, it does not apply to specific beliefs produced by innate belief-producing mechanisms. For instance, even if we agreed that the capacity for causal reasoning is innate, we cannot assume that every causal belief a person ever forms or acquires is accurate (although presumably these beliefs must be accurate enough often enough to enhance fitness). Nonetheless, the EA may provide support for the implicit concepts and general principles underlying this faculty – that is, the concept of cause and the notion that some events cause or produce other events. In other words, the existence of an evolved faculty of causal reasoning would not justify specific causal beliefs, but it might justify a realist position on the issue of causation. Similarly, if theory of mind has an evolutionary origin, this would not imply that every attribution of a belief or desire to another individual is accurate. However, it might justify the more general belief – implicit in the operation of theory of mind – that other people do possess minds. The EA only applies to innate content and the implicit principles underlying innate psychological mechanisms. As such, the fact that more than half of Americans believe that extraterrestrials live among us is not a threat to the EA, and nor are the errors in reasoning that psychologists have shown can be evoked in certain situations (e.g., Kahneman et al. 1982). These beliefs and judgements may derive from innate belief-producing mechanisms, but they are not themselves innate. As such, they are beyond the scope of the EA.

In summary, according to the EA, an analysis of the innate contributions to our construal of the world is a potential source of knowledge. The basis of this argument is that these contributions were selected in the process of our evolution, and that this vouches for their relative accuracy. Furthermore, to the extent that our innate ideas relate to topics in metaphysics, we can view them as a naturalistic source of metaphysical knowledge.

Meeting the critics

The EA has an initial appeal. However, important criticisms can be levelled at evolutionary approaches to the justification of knowledge. In this section, I will consider three: the EA is circular, innate content and principles are not necessarily accurate, and the EA has certain implausible implications, for instance, supporting the existence of objective moral truths and objective aesthetic truths.

Evolutionary justifications are circular

Many philosophers have argued that appeals to evolution (or science in general) in answering epistemological questions are circular (Putnam 1983; Stroud 1985; Bradie 1986; Clark 1987). According to this view, the appeal to

evolutionary theory in justifying the accuracy of innate mental content and the principles underlying innate mechanisms fails because evolutionary theory itself presupposes the very assumptions that it is used to justify. As an example, consider the evolutionary justification of induction. This involves justifying induction with reference to a theory that is itself justified with inductive arguments. Quine (1975) made this point well. He asked why our inductions tend to come out right, and found an answer in Darwin: 'Creatures inveterately wrong in their inductions have a pathetic but praiseworthy tendency to die before reproducing their kind' (Quine 1969, p. 126). This has sometimes been mistaken for an attempted evolutionary justification of induction (see, for example, Stich 1990). However, Quine did not maintain that the EA could defeat the sceptic.

> I am not appealing to Darwinian biology to justify induction. This would be circular, since biological knowledge depends on induction. Rather, I am granting the efficacy of induction, and then observing that Darwinian biology, if true, helps explain why induction is as efficacious as it is. (Quine 1975, p. 70)

As this quotation indicates, an evolutionary explanation for the origin of inductive reasoning must be distinguished from an evolutionary solution to the philosophical problem of induction. The former may be viable, but the latter fails because it rests on a circular argument. It seems, then, that Darwin has no answer for Hume. But can he defeat Descartes' demon? As mentioned, the tendency to interpret sensory experience as revealing an external world may be a product of natural selection. According to the EA, the fact that this tendency was selected indicates that it was genetically useful, and the simplest explanation for its usefulness is that it is accurate. However, like the evolutionary solution to the problem of induction, this argument is plagued by circularity. As with science in general, the theory of evolution presupposes the existence of an external world. As such, any philosophical argument for the existence of an external world based on evolutionary theory begs the question against the radical sceptic (Rorty 1979; Clark 1987). The upshot of this and the previous argument, claim the critics, is that evolutionary theory cannot defeat scepticism concerning an external world or inductive justification (O'Hear 1997). There may be other reasons to accept the reality of an external world and the validity of induction, but the evolutionary account of the origin of induction and metaphysical realism is not among them.

The EA is weakened by the circularity charge. However, it may not be necessary to reject it outright. The first point to make – a point that is often overlooked by the critics – is that the circularity criticism does not apply uniformly to evolutionary justifications for all innate content and principles. It would not apply, for instance, to the attempt to justify belief in the existence of other minds with reference to the evolutionary origin of theory of mind, because evolutionary theory does not presuppose a belief in other minds. In addition, evolutionary theory does not pre-suppose any particular view on the

topics of space, time, or causation, and thus the circularity criticism would not apply in these domains.

Furthermore, even where the EA does involve circularity (for instance, in the justification of induction and metaphysical realism), this may not always be a vicious circularity (Vollmer 1987a; Clendinnen 1989; Goldman 1990; Meyers 1990). In some cases, it may be possible to argue that the discovery of innate mental content reveals a new layer of coherence in the scientific worldview. If we assume the validity of the metaphysical assumptions of science, such as the assumption of an independently existing external world, we then find confirmation of these assumptions in the evolutionary analysis of our innate or evolved tendencies of belief. This provides some support for the validity of these assumptions by showing that the scientific worldview is at least coherent. Coherence may not be an adequate criterion for truth, but it is at least a precondition for the truth of a worldview. This may not seem like much of a victory, but given that the problem of radical scepticism has haunted Western philosophy for centuries, and that the problem is commonly viewed as intractable, it may be the best that can be expected. The EA does not completely resolve the problem, but this does not mean that it makes no contribution at all.

On the other hand, the coherence argument cannot salvage the evolutionary justification for induction. Even if the innateness of inductive reasoning implies that induction was useful over the course of our evolution, we have no guarantee that it will continue to be useful in the future. Inductive reasoning exists now purely because it has worked in the past. The problem is not that the argument is circular; the problem is that an evolutionary account of the origin of inductive reasoning does not avoid Hume's challenge. As such, an evolutionary approach to psychology cannot solve the problem of induction. According to Ruse (1986), the proper Darwinian response is to concede that inductive reasoning is not ultimately justifiable and to give up the attempt. Nonetheless, if we follow Quine and simply grant the efficacy of induction, it may still be possible to apply the EA to other innate tendencies of belief. The conclusions we have reached so far are: (1) that when the application of the EA involves circularity, the best argument that can be made for accepting the truth of an innate tendency of belief is that to do so increases the coherence of our worldview; and (2) that the EA does not always involve circularity.

Innate content and principles are not necessarily accurate

Another criticism of the EA relates to the accuracy of innate mental content and principles (Stich 1990). In areas in which science has made good progress, it has become clear that our natural tendencies of belief are often far from accurate. Many facets of modern science are deeply counterintuitive. In particular, many aspects of intuitive physics disagree with those of scientific physics. Various concepts that in the past were viewed as so certain that they

were classed as metaphysical necessities have since been overturned by physics. Nozick (2001) summarizes:

> *Every event has a cause* – gone with the formulation of quantum mechanics. *Space is Euclidian* – gone with the formulation of consistent non-Euclidian geometries and their adoption in contemporary physics. *Space has constant curvature* – gone with General Relativity…. *For any two events, one temporally proceeds the other, or the other proceeds it, or the two are simultaneous* – modified in Special Relativity…. *The world exists in a definite state independently of our observations* – shaken by quantum mechanics. (p. 133)

In short, it appears that scientific thinking is more accurate but less natural to us than other systems of thought (McCauley 2000). This raises an important question: How could an inaccurate view of the world be maintained in the process of natural selection? The key to answering this question is to challenge the assumption, implicit in the EA, that biologically useful beliefs must be accurate. Many commentators have pointed out that true or highly accurate beliefs are not always more evolutionarily useful than false beliefs or approximations. Fitness enhancement may result from highly restricted and selective cognitive mechanisms, and from mechanisms that are subject to error or even actively and consistently deceptive (Vollmer 1987b; Stich 1990). In short, usefulness and truth do not always coincide[1]. This is an important challenge to the EA, and its implications are considered in the following sections.

Selection for approximate truth

One reason to doubt that accuracy and usefulness will coincide is that selection often produces psychological mechanisms that yield approximate truth rather than exact truth. There are various reasons for this. First, adaptations are often far from optimal. Natural selection does not produce perfection and therefore may often not produce a close fit between the organism and its environment. As such, if certain tendencies of belief are adaptations, 'we should expect a gap between [these] beliefs and the physical world comparable to that which we find between animal form and ecological niche' (Campbell 1982, p. 172). An evolutionary perspective leads to the expectation that the mind will exhibit design flaws, quirks, and 'bugs'. Of course, people have always realized that the mind is imperfect; an evolutionary approach simply helps to *explain* this fact (Vollmer 1984). What is most significant for present purposes, however, is that we should be wary about inferring accuracy from innateness (O'Hear 1997).

Another reason that selection may favour approximations is that a high degree of accuracy is often unnecessary. It has been suggested that the only

[1]Of course, according to a pragmatist account of truth, usefulness and truth coincide as a matter of definition. From this perspective, there could be no such thing as an adaptive falsehood (at least not if usefulness were identified with *evolutionary* usefulness).

things that frogs can perceive are shapes in motion (Lettvin et al. 1959), but that this is adequate for adaptive action. This shows that simplifications may be adaptive and thus that adaptiveness does not necessarily imply accuracy. We should not expect that selection would construct perfectly accurate beliefs except where accuracy and simplicity happen to coincide. In addition, an adequate, fast approximation is likely to be selected over an accurate but cumbersome calculation (O'Hear 1997). The intuitive human understanding of the geometry of space provides a suitable illustration. Until recently, it was believed that Euclid had assembled a set of self-evident, logically necessary truths about physical space. This tidy picture was shattered by the development of non-Euclidian geometries and their eventual incorporation into Einstein's general theory of relativity (Nerlich 1994). The implication of this transition is that 'counter-intuitive non-Euclidian geometry is appropriate for the description of reality and even seems to be more adequate' (Vollmer 1984, p. 106). Nonetheless, Euclidian geometry is more closely allied with our common sense view of space than non-Euclidian geometries, and it is possible that this can be traced to the evolved design of the mind (Lorenz 1982; Stewart-Williams 2004). Euclidian geometry is presumably a close enough approximation for the purposes of inclusive fitness. Furthermore, the neural resources required to represent a more accurate geometry may have made it prohibitively expensive (Nozick 1993).

Euclidian geometry is a clear example of an intuitively plausible system that now appears to be false, but it opens up the possibility that there are others. Nozick (2001) asked whether, like Euclidian phenomenological space, the concept of *truth* is a product of evolution but is not strictly accurate. It may be a part of a folk epistemology, which is imperfect and may disappear if a better epistemology is devised. Similarly, "Just as Euclidian geometry need only have been 'true enough,' so too the belief in other minds and in an independently existing external world could become fixed (via the Baldwin effect) *without* being strictly speaking true" (Nozick 1993, p. 123). Like the frog's representation of the world, these beliefs need only be true enough for genetically useful action.

Not only may a useful belief be a crude approximation, it may also be an adaptive falsehood. A number of thinkers have suggested that, in some conditions, selection will favour adaptive biases (Sober 1994; Godfrey-Smith 1996; Haselton and Buss 2000). For instance, animals may tend to err on the side of false positives in the identification of threats, under the principle that it is better to mistake a vine for a snake than it is to mistake a snake for a vine. Stephens (2001) calls this the *better-safe-than-sorry* principle. In some cases, selection may also favour false negatives (Godfrey-Smith 1996). For instance, people may have an evolved tendency to overlook any evidence of goodwill on the part of outgroup members, under the principle that it is better to be unduly suspicious than it is to be too trusting of a scheming enemy. More germane to the present discussion, there are various potential examples of adaptive biases related to topics in metaphysics. For instance, where there is any ambiguity,

people may err on the side of assuming the objectivity of our mental states over subjectivity (Stewart-Williams 2003), and of assuming causation over coincidence (Stewart-Williams and Hill, article submitted for publication). As noted, the EA does not justify specific beliefs produced by innate belief-producing mechanisms but only the general principles underlying these mechanisms. However, in both of these examples, it seems that the underlying principles are somewhat skewed. In the first example, there is an overestimation of the likelihood that a mental event has an objective referent; in the second, there is an overestimation of the extent that events are causally related. Thus, the principles underlying the respective mechanisms are only approximately true.

The overall conclusion is this: Selection will often favour approximations rather than precise truths. As such, we cannot safely make inferences from innate cognitive tendencies to the nature of the world.

How might advocates of the EA respond to this conclusion? To begin with, it should be noted that advocates are perfectly willing to concede that any innate contributions to our view of the world are likely to be mere approximations (Lorenz 1977, 1982; Vollmer 1987b). Furthermore, it is worth pointing out that there is a danger that the criticism may be used selectively. Critics of the EA argue that the beliefs embodied in our evolved tendencies of knowledge-production are not infallible; however, the evidence of our senses is also not infallible. If fallibility is an adequate reason to reject innate mental content and principles as a source of knowledge, then to be consistent, the critics must also reject sensory information as a source of knowledge. Similarly, the critics argue that our evolved intuitions (assuming, of course, that we have any) are likely to be approximations and therefore false given a strict enough criterion. This certainly seems to be a reasonable assertion, and if advocates of the EA were committed to the belief that innate ideas are *perfectly* accurate, their position would not be salvageable. But this applies equally to all empirical knowledge. If the approximation argument implies that evolved contributions to our knowledge must be rejected, it also implies that all scientific beliefs should be rejected. We cannot reject innate predilections as a source of knowledge on the grounds that they are imperfect approximations but then retain other sources that are equally imperfect. Unless the critics are willing to embrace global scepticism – which presumably most will not – the approximation criticism does not provide adequate grounds to reject evolved contributions as a source of knowledge.

What *is* the proper response to the approximation criticism? The criticism may be better viewed as a qualification of the EA rather than a refutation. For example, belief-desire folk psychology may, strictly speaking, be false. Nonetheless, it may be *more* accurate to say that it is true than to say it is false. (Compare: The earth is not perfectly spherical; nonetheless, it is closer to the truth to say that it is spherical than to say it is flat.) Similarly, it might be argued that the common sense notion of causation (the idea that one event is necessitated by an earlier one) stands at least as a good first approximation, as does the concept of *persisting object*. I return to this issue later.

There is another problem, though. Even if in some cases any innate contributions to our picture of the world can be viewed as approximations, their approximate accuracy may hold only within a certain narrow range of circumstances. Newtonian physics is accurate enough to describe our everyday world but breaks down in extreme conditions, such as in a strong gravitational field or when travelling close to the speed of light (d'Inverno 1992; Taylor and Wheeler 1992). Similarly, our innate concepts and beliefs may be accurate enough for adaptive action in a terrestrial environment but break down in extreme conditions (extreme, that is, relative to the conditions in which we evolved). Any innate contributions to our view of the world were shaped in a particular range of environmental circumstances, the environment of our hunter-gatherer ancestors and pre-human ancestors.[2] Consequently, these contributions may not be reliable outside that range or outside the sphere of what is biologically relevant (Hahlweg and Hooker 1989a). More broadly, it might be argued that, when it comes to the abstruse questions dealt with by philosophers and physicists, our intuitions should probably be given little weight.

Causal cognition provides a good example. It is probably reasonable to think that causal cognition is appropriate within the conditions and circumstances for which it evolved. In this range of conditions, it may be a close enough approximation to be biologically useful. However, outside this range, it may simply be inapplicable. Indeed, intuitive causal cognition appears not to work at the micro level described by quantum mechanics, where the idea that every event has a cause appears not to hold. In addition, it is entirely conceivable that causal cognition is not applicable to philosophical questions far removed from the evolutionary needs of our ancestors. Take, for example, the question of why there is something rather than nothing. Just as causal cognition is apparently not applicable at the quantum level, it may not be applicable to questions such as this. That is, we should be extremely cautious about accepting that there must be a causal answer to the question of why there is something rather than nothing. One popular answer to this question is to posit God as First Cause. However, we cannot rely on the intuition that there must be an ultimate cause for the universe as a whole. Thus, an important philosophical implication of evolutionary psychology is that it weakens the First Cause argument for the existence of God.[3]

---

[2]Thus, an epistemological implication of evolutionary psychology is that our view of the world is to some extent a view of the world in the past.

[3]I am not arguing that, as a result of our evolutionary origin, humans are constitutionally unable to answer questions such as why there is something rather than nothing (although maybe we are). All I am arguing is that our intuitive categories may be inadequate for this task. Rather than ruling out the possibility of answering these questions, this realization may be a necessary step *toward* answering them.

Like intuitive causal cognition, intuitive physics is only applicable to mid-size physical entities and processes (Carey and Spelke 1994). Our intuitions about the physical world do not extend to the very fast (special relativity), the very large (general relativity), or the very small (quantum physics). Consider quantum physics. We understand the apparently rational workings of the human-scale world fairly well. However, Niels Bohr, one of the key players in the quantum revolution, suggested that the human mind is simply not equipped to understand the quantum world (O'Hear 1997). Bohr famously suggested that: 'Anyone who is not shocked by quantum mechanics hasn't understood it.' This quotation captures the fact that quantum mechanics does not square with intuitive physics. According to an early interpretation of quantum phenomena, there is discontinuity in the motion of subatomic entities (Miller 1987), contrary to the common sense intuition that motion is continuous (Spelke 1990). As Lorenz (1982) dryly noted: 'It is as though the ''measure of all things'' was simply too coarse and too approximate for these finer spheres of measurement' (p. 134).

The strangeness (to us) of quantum physics, and of relativity theory, is consistent with an evolutionary origin for specific components of our intuitive view of matter, space, time, and gravity. Indeed, the fact that these theories seem strange to us is *explained* by an evolutionary approach to the mind (Vollmer 1984). However, an evolutionary approach is inconsistent with the view that innate content or principles are even approximately true outside the range of circumstances associated with our cognitive evolution. Based on considerations such as these, Hahlweg and Hooker (1989a) reached the following conclusion:

> Bioepistemology provides philosophers with a tool for criticism. The message is: Don't trust your perceptual and conceptual structures once you leave the safe grounds of everyday experience; criticize even the most basic presupposition such as our concepts of causation, of induction, our space-time framework, and even our logic. Therefore the main function of bioepistemology is to assist us in freeing ourselves from anthropocentric preconceptions of which we may not be aware. (p. 29)

Can the EA be salvaged? Again, the criticism that innate content and principles are only locally applicable may be best viewed not as a refutation of the EA but instead as a refinement (albeit a rather significant refinement). We have no reason to assume the accuracy of innate tendencies of thought in matters beyond the sphere of everyday life. However, within the range of their applicability, the EA might yet work. So, for example, if we wish to justify our concept of causation on the grounds that it has an evolutionary origin, our conclusion must be restricted to the sphere and scale of reality relevant to human cognitive evolution. Just as our understanding of causation breaks down at the quantum level, our intuitive understanding of induction and the external world may break down at this level too. But this is not to deny that our understanding in these domains represents a valid approximation at the

macroscopic level. The most accurate view of the universe may come from maintaining our evolved concepts and tendencies of belief, but keeping in mind the limited range of their application. This may be a better approach than either rejecting them altogether or accepting them without the proviso.

Evolutionary justifications have implausible consequences

A third criticism of the evolutionary approach to the justification of knowledge is that, if taken to its natural conclusion, it has certain highly implausible consequences. The EA appears to amount to the assertion that we should accept our intuitions as local approximations as long as it can be shown that they trace to the evolved design of the mind. This produces plausible results in some cases. For instance, if causal cognition were not at least somewhat accurate, it is difficult to see how it could have been crafted by natural selection. However, in other cases, the EA is not so plausible. An example relates to the philosophical issue of the relationship of mind to brain. Mind–brain dualism appears to be more intuitively plausible for most people than monistic approaches such as identity theory or functionalism. This intuition may trace to the evolved nature of the mind/brain. Various commentators have proposed that we have separate evolved mental mechanisms for thinking about physical bodies and for thinking about minds (e.g., Leslie 1994). This may help explain the initial plausibility and perennial popularity of dualism, and why physicalist theories seem so implausible to people. But if the EA implies that our intuitive predilection for mind–brain dualism provides support for dualism, then the EA is on shaky ground. After all, many modern philosophers reject mind–brain dualism (Dennett 1991), and this is particularly so among evolutionary epistemologists (Hahlweg and Hooker 1989b).

It seems that in some cases, the EA furnishes reasonable conclusions, but in others, it does not. This casts a shadow of doubt on its reliability. The argument must be rejected – unless, that is, we can find a principled reason to reject our philosophical predilections related to issues such as the mind–brain relationship but retain those related to issues such as causation. The key to doing this may be found in the fact that the capacity for causal cognition is plausibly innate, whereas our intuitive stand on the mind–brain issue is not. The latter may be intuitively compelling to us as an indirect result of the innate design of the mind (i.e., the fact that we have separate evolved mechanisms for reasoning about the physical vs. the mental), but it is not itself innate. This is an important difference. If we accept that the capacity for causal cognition is an adaptation, we have some reason to think that the principles implicit in this form of cognition are accurate – after all, if it were not, the capacity would not have been selected. In contrast, if our 'Cartesian intuitions' are simply a selectively neutral artefact of the functional specialization of the human brain, there is no reason to think that they need to be useful or accurate. We must add another stipulation to the EA: It applies only to innate content crafted by

natural selection and not to ideas that are simply intuitively compelling as an indirect result of the innate design of the human mind.

However, even if we restrict our attention to content and principles that are directly innate, the EA still has some implausible consequences. Evolutionary psychologists maintain that some components of moral psychology and of our moral beliefs have an evolutionary origin (Trivers 1971; Alexander 1987; Petrinovich et al. 1993; Krebs 1998). But would we want to argue that this provides any assurance that our moral beliefs are literally true, or that an analysis of the innate contribution to these beliefs would provide us with knowledge of objective moral truths? Many thinkers would find this position unpalatable. After all, moral beliefs are a good candidate for beliefs that confer an evolutionary advantage but are false (Joyce 2001).

Given that many thinkers doubt the very existence of objective moral truths, the fact that the EA implies that any innate moral beliefs are objectively true must lead us to question whether the EA is valid. And if one is not too troubled by the notion of objective moral values, consider aesthetic tastes instead. Some standards of physical beauty used in mate choice appear to have an evolutionary origin (Buss 1989; Jones 1996; Gangestad and Thornhill 1997; Shackelford and Larsen 1997, 1999), as do landscape preferences (Kaplan 1992; Orians and Heerwagen 1992; Thornhill 1998). The evolutionary function of these preferences is not related to any objective facts about what is beautiful, and indeed there is no reason to think that there are such facts. However, if the evolutionary origin of, say, the belief in other minds counts as proof of the objectivity of other minds, then presumably the evolutionary origin of our aesthetic preferences must count as proof of the objectivity of our aesthetic preferences. Again, when pressed, the EA has implausible consequences. These consequences of the EA seem to show, by *reductio ad absurdum*, that the argument is false.

With some further qualifications, however, it may once again be possible to salvage the argument. The key is a consideration of the purposes for which different components of our psychology evolved. In the case of innate content and principles related to causation, space, time, and the existence of an external world and other minds, the evolutionary advantage presumably relates to the accuracy of our understanding of the world. The evolutionary advantages of our moral beliefs and aesthetic preferences, however, are unrelated to their objective truth or falsity. The evolutionary explanation of innate influences on our moral beliefs, for example, revolves *solely* around the effects that these have on the way we treat one another. From an evolutionary perspective, it does not matter how much or how little our moral beliefs correspond to any objective moral truths, even if such truths existed.[4] This type of functional

[4]It might be objected that the evolutionary utility of folk psychology also revolves around how we treat one another. The difference is, however, that behaviour prompted by folk psychology is presumably useful only to the extent that our understanding of other people is accurate, whereas the usefulness of our moral beliefs is unrelated to their objective truth or falsity.

analysis provides a principled approach to distinguishing which aspects of our innate psychology can provide knowledge of the world and which cannot. We can ask this question: If the objective facts were different, would natural selection still favour the same tendency of belief? If the answer is 'no,' we have some reason to think that the belief in question is at least approximately true. On the other hand, if the answer is 'yes,' then an evolutionary psychological perspective offers no reason to think that the belief is true. In principle, it may be, but the mere fact that we have an inherited tendency to think it true is no proof that it actually is.

Application and implications of the EA

Where does this leave us? Many of the ideas emerging from metaphysics challenge our intuitive views, as do the ideas emerging from modern science. Given that science contradicts our intuitions in the scientific realm, what reason do we have to trust our intuitions in the realm of metaphysics? This might sound like a rhetorical question, but in this section, I will attempt to find an answer. Although science and metaphysics both make counterintuitive claims, there is an important difference between the two areas. Whereas in science there is at least some consensus about the progress we have made and the direction we are headed, metaphysics is notorious for its lack of established findings. If metaphysicians were able to resolve controversies and reach consensus through the methods they presently use, then we would probably be wise to bow to their expertise, regardless of whether their conclusions squared with our evolved intuitions. It is not clear, though, that such progress has been made. Given this state of affairs, it seems reasonable to propose a new method for metaphysics, a method that involves taking the EA seriously. In this section, I draw together the strands from the previous discussion and describe how to apply and interpret the EA.

When is the EA applicable?

The first step in applying the EA is to ascertain which beliefs and principles are potential candidates for justification by the EA. For the reasons already discussed, the EA should only be applied when dealing with content that is innate, as opposed to content that is merely intuitively appealing as an indirect result of the innate design of the mind. Furthermore, it should only be applied when the evolutionary function of the innate content is plausibly dependent on its (approximate) correspondence with the external world. These stipulations immediately rule out a number of pivotal topics in metaphysics. Consider, for instance, whether the EA can be used to justify a belief in God. The first question would be whether belief in God is innate or merely intuitively appealing as an indirect result of the innate design of the mind. Although some

have argued for the former position (e.g., Hamer 2004), a good case can be made that the concept of God is simply intuitively appealing as a by-product of an innate tendency toward anthropomorphic explanations and interpretations of the world (Guthrie 1994). If this is the case, then the EA is not applicable. On the other hand, if the belief does turn out to have an innate basis, it has passed the first hurdle. The next question would be whether it depends for its evolutionary usefulness on its approximate correspondence with the external world. Most explanations for the innateness of the belief in God revolve around the effects of this belief on people's well-being or on social cohesion (Wilson 2002; Hamer 2004). But such explanations do not require the existence of God in order to work. For these reasons, belief in God is not a candidate for a belief that can be justified by the EA. Contrary to Descartes, the innateness of the concept of God would not constitute evidence for the existence of God.

In many other cases, though, the initial demands will be met. Whenever this is the case, we must next ask whether the application of the EA to a given aspect of innate mental content is circular. If it is, then the best that can be achieved is to employ the coherence argument: We can tentatively assume the accuracy of the content in question because doing so increases the coherence of our worldview. This argument applies, for instance, to the justification of belief in an external world, and provides a partial answer to the radical sceptic. If, on the other hand, there is no circularity, the interpretation of the EA is very different.

First approximations and final approximations

Where the use of the EA is appropriate and non-circular, its main implication is that, in matters where science has not progressed beyond evolved intuitions, our evolved knowledge provides a good first approximation (at least within the sphere of reality in which our cognitive evolution took place). Furthermore, where science *cannot* speak, our evolved knowledge may also have to serve as a final approximation.[5] This position contains an answer to the question of how, if we know that our intuitions related to topics in science are inaccurate, we can put any faith in our intuitions related to topics in metaphysics. Granted, even the most intuitively compelling theory of common sense may be wrong. The problem is, though, that beyond this conclusion, we are left with little guidance in choosing among philosophical theories. Without evidence to guide a change in belief, we would have no idea in which direction we should change it. Even if we agree that an intuitive theory may be inaccurate – indeed, is almost certain to be inaccurate – this does not imply that a counterintuitive theory will be *more* accurate. Our beliefs may be closer to the truth if we hold an intuitive

[5]The latter circumstance applies to topics in metaphysics almost as a matter of definition, which hints at the potential importance of the EA for the discipline of metaphysics.

false belief than if we hold a counterintuitive false belief. The EA will not lead us to perfectly accurate beliefs, but it may help us to choose the least inaccurate ones available to us.

Further guidance in interpreting the EA comes from the observation that, although science has reached many counterintuitive conclusions, our intuitive predilections tend to make sense in light of these conclusions, and it is generally apparent how the unrefined intuition could be an adequate approximation. For instance, Newton's first law of motion (which states that objects continue in their state of motion or rest unless acted on by a force) contradicts the intuition that the natural state of an object is to be at rest and that all motion requires the ongoing application of force (Resnick 1994). However, the usefulness of the intuition makes sense in light of the scientific understanding of friction. The Aristotelian conception of the physical universe is a more accurate description of our phenomenological world than is Newton's conception, due to the pervasive influence of friction (Stewart and Cohen 1997). Another example: Science has reached the counterintuitive conclusion that matter consists mainly of empty space, and that we perceive 'a continuous flux of forces and events in terms of stable and enduring material objects' (O'Hear 1997, p. 57). However, our intuitive conception of matter is perfectly consistent with the way matter appears to us at the macrocosmic level: as solid, stable, and continuous. The lesson is that we should be extremely suspicious of any philosophical theory that, rather than refining our evolved intuitions, directly and completely contradicts them, unless the theory explains how these intuitions could be evolutionarily useful approximations. Until that time, we are justified in accepting innate beliefs and principles as local first approximations. More generally, the standard of evidence required for accepting philosophical positions that defy innate intuitions should be much higher than the standard of evidence required for accepting positions that are consistent with these intuitions.

These recommendations may sound like mere truisms when stated in the abstract – according to a reviewer of this article, they amount to little more than the assertion that we should be sceptical of views that go against our intuitions, especially when we cannot explain the usefulness of the intuitions they discount. Even if this characterization were accepted, it might be argued that it is nonetheless a valuable result. After all, the EA provides an *argument* for these truisms, an argument founded on one of the most successful scientific theories ever devised. In any case, there are good reasons to dispute the idea that the EA leads only to truistic conclusions. The reviewer's summary missed one crucial point: The conclusions apply only to innate mental content and the principles underlying innate psychological mechanisms, and only when the evolutionary significance of the content or principles derives from its approximate correspondence with the external world. The EA offers no support for appeals to intuition on a number of issues, including the relationship of mind to brain, the existence of objective moral truths, and the existence of God. In these and other cases, the EA is *at odds* with the truism that we should be sceptical of beliefs that go against our intuitions. In short, the EA does not

simply justify appeals to intuition. It specifies conditions in which appeals to intuition are appropriate but also specifies conditions in which they are not.

Furthermore, the implications of the EA may seem less truistic when we stop considering them at a general level and instead consider specific examples of the argument's application. In some cases, the EA may urge conclusions that are far from popular among philosophers. One example concerns the correspondence theory of truth – the much-maligned notion that a statement or belief is true to the extent that it corresponds to the facts. Our innate conception of truth, if we possess one, is most plausibly something akin to correspondence theory (Goldman 1999; Nozick 2001). Therefore, the EA would justify accepting this view as a first (and perhaps final) approximation. Of course, innate content and principles are not necessarily accurate, and therefore it is perfectly possible that the notion of correspondence does not perfectly capture the nature of truth. But although innate ideas are not necessarily accurate, the refinements made to them tend not to completely reverse them – they leave room to understand how the initial version was a useful first approximation. Coherence, pragmatic, and deflationist theories of truth, rather than refining correspondence theory, completely refute it. As such, if the notion of correspondence truth has an innate basis, we should be extremely suspicious of the alternative theories. The standard of evidence and argument required in support of these approaches to truth should be much higher than that required for correspondence theory. On the other hand, if the notion of correspondence truth does not have an innate basis, correspondence theory would not enjoy a privileged position in relation to any other theory of truth, despite the fact that it is the common sense position.

If taken seriously, the EA could have an important impact on the agenda of philosophy. The EA points us toward where our philosophical efforts are best placed. For example, it suggests that, given our present understanding, efforts to justify correspondence approaches to truth are less likely to be a waste of one's time than are efforts to justify deflationist theories. Similarly, efforts to devise realist theories of causation, space, and time are less likely to be misplaced than are efforts to devise antirealist theories in these domains. (In contrast, the EA has no such implications for realist vs. antirealist accounts of moral truths.) Admittedly, the evolutionary approach does not locate the faults in arguments for conclusions that defy innate intuitions. At the very least, though, the approach points us to the task of finding such faults, and it suggests that this will probably be more fruitful than looking for faults in conclusions that are consistent with innate intuitions. In providing this guidance, the EA helps to set the agenda for philosophy and philosophers.

Going beyond evolved intuitions

The next matter to consider is how we might proceed beyond our evolved intuitions. The development of atomic physics in the first third of the

20th century provides a good example of a successful transition from intuitive starting points to a highly counterintuitive theory. Miller (1987) pointed out that Rutherford's initial model of the atom as a miniature solar system was based on intuitions such as object permanence – intuitions that plausibly have an evolutionary origin (Stewart-Williams 2003). Bohr's 1913 model was less intuitive: Although still visualizable, it included the counterintuitive notion of electrons making quantum leaps, which defies the intuitive principle that objects occupy linked regions of space and time (Spelke 1990). It was not until 1925 that Heisenberg finally dropped the notion of visualizable solar system atoms (Miller 1987). This provides a good model for how to proceed from intuitive to counterintuitive judgements: cautiously and only if the evidence genuinely seems to demand it.

A promising method of progressing beyond intuitive starting points involves linking innate mental content to current scientific knowledge. Research on disgust has revealed that, when an object classed as a contaminant touches another object, people typically view the latter object as contaminated also. The degree of contamination is independent of the length of contact – even the slightest touch transmits it completely. This ancient adaptation matches a fact about the world that is invisible to us and was only recently discovered: the fact that germs multiply and therefore that even the slightest contact can soon result in complete contamination (Boyer 2000). This is an example of how parts of our construal of the world that were previously inexplicable can make sense as science uncovers aspects of nature that natural selection has been fitting our minds to, but which we had not dreamed existed. It would be naïve to assume that all innate content simply depicts reality as it is. However, it may be reasonable to make the weaker assumption that such content corresponds to *something* in reality. We might look to science for suggestions as to what that something might be.

By way of illustration, consider causal cognition. To what feature of reality might this cognitive competency be adapted? A number of evolutionary epistemologists have suggested that the answer to this question is *energy transfer* (Lorenz 1982; Vollmer 1984). As Lorenz (1982) put it: 'The essence of 'propter hoc' which alone differentiates it qualitatively from a 'uniform post hoc' lies in the fact that cause and effect are successive links in the infinite chain of phenomenal forms that energy assumes in the course of its everlasting existence' (p. 138). So, for instance, we would say that the collision of one billiard ball with another *causes* the second ball to move, because this sequence of events involves a transfer of energy (in particular, kinetic energy). In contrast, we would not say that the rooster crowing causes the sun to rise, because this sequence does not involve energy transfer. I am not suggesting that this interpretation of causation is necessarily correct; it is not clear, for example, that mental causation can be understood in terms of energy transfer. However, the example does illustrate a potentially useful approach to going beyond evolved intuitions.

Future directions

There are various directions that future work in this area might profitably take. First, cross-species research may provide further data concerning whether any given example of innate mental content accurately depicts the world. The more widespread any innate mental content is in the animal kingdom, the better a candidate it is for knowledge rather than mere belief. For example, if the concept of God has an evolutionary origin in human beings (which is far from certain), it is presumably only found in members of our species. As such, we would have less confidence that this aspect of mind relates to an objective reality than we would have in the case of a more widespread innate tendency, such as the tendency to construe the world in terms of objects situated in three-dimensional space.

Cross-species commonalities in innate mental content may be a product of a common origin or of convergent evolution. The products of convergent evolution would be more convincing candidates for genuine innate knowledge. An analogy can be drawn between convergent evolution and convergence as a criterion for truth in science. Where there is convergence in scientific research and theory, we can be more confident that our theories are zeroing in on an accurate view of some part of reality. Similarly, if it could be shown that some aspect of the cognitive systems of various different species was a product of convergent evolution, this would provide stronger evidence that this aspect corresponds to reality than would innateness in a group of species that inherited it from a common ancestor.

Another principle that could be exploited in future research is this: The more ancient a cognitive adaptation is, the more accurate it is likely to be. This is because longer standing adaptations have, in a manner of speaking, resisted falsification for longer. Many animals appear to have cognitive adaptations related to physical objects (Wynne 2001), which suggests that adaptations that mesh with the physical world are very ancient. They have been subjected to a longer period of selection than more recent cognitive adaptations, such as theory of mind, which may mean that they have been honed to a greater degree and are more reliable. This may help to explain why the physical sciences are better established and more advanced than the psychological sciences.[6] Finally, the development of mass society is too recent to be associated with any complex psychological adaptations. Consequently, human beings may tend to be poor intuitive sociologists.

Conclusion

There are an unlimited number of possible theories, most of which are wrong, and although any evolved contributions to our view of the world are also likely

[6]On the other hand, this could simply be because the physical level of analysis happens to be simpler and more predictable than the psychological.

to be wrong, we may get *closer* to the truth by accepting these contributions as first approximations than by simply rejecting them, at least in the absence of compelling reasons to do so. Furthermore, where science cannot speak, our first approximations may also have to stand as final approximations. This argument can only be applied in the case of innate content or principles that are dependent on their approximate correspondence with the external world, and only within the sphere in which cognitive evolution took place. Evolutionary theory does not solve the problem of induction or contribute to questions such as the relationship of mind to brain, the existence of objective moral truths, or the existence of God. Nonetheless, it may contribute to various other problems in philosophy. An evolutionary account of belief in an external world provides some support for the existence of such a world by increasing the coherence of the scientific worldview. The EA also provides a partial solution to the problem of other minds, and suggests that innate content related to space, time, causation, and truth may serve as a good first approximations, at least within the range of circumstances of our cognitive evolution. Although the EA must be carefully qualified, it seems reasonable to think that, in some circumstances, innate ideas can be viewed as a naturalistic source of metaphysical knowledge.

Acknowledgements

This article was supported by a Bright Future Top-Achiever Doctoral Scholarship, administered by the Foundation for Research, Science, and Technology (FRST). Thanks to James Battye, Stephen Hill, John Podd, and Jane Stewart-Williams for helpful comments on an earlier version of this article.

References

Alexander R.D. 1987. The Biology of Moral Systems. Aldine de Gruyter, Hawthorne, NY.

Baron-Cohen S. 1995. Mindblindness: An Essay on Autism and Theory of Mind. MIT Press, Cambridge, MA.

Boyer P. 2000. Natural epistemology or evolved metaphysics? Developmental evidence for early-developed, intuitive, category-specific, incomplete, and stubborn metaphysical presumptions. Philos. Psychol. 13: 277–297.

Bradie M. 1986. Assessing evolutionary epistemology. Biol. Philos. 1: 401–459.

Buss D.M. 1989. Sex differences in human mate preferences: evolutionary hypotheses tested in 37 cultures. Behav. Brain Sci. 12: 1–49.

Campbell D.T. 1982. Evolutionary epistemology. In: Plotkin H.C. (ed.), Learning, Development, and Culture: Essays in Evolutionary Epistemology. Wiley, Chichester, England, pp. 73–107.

Campbell D.T. 1987. Selection theory and the sociology of scientific validity. In: Callebaut W. and Pinxten R. (eds), Evolutionary Epistemology: A Multiparadigm Program. Reidel, Dordrecht, Netherlands, pp. 139–158.

Carey S. and Spelke E. 1994. Domain-specific knowledge and conceptual change. In: Hirschfeld L.A. and Gelman S.A. (eds), Mapping the Mind: Specificity in Cognition and Culture. Cambridge University Press, New York, pp. 169–200.

Carnap R. 1967. The Logical Structure of the World. Pseudoproblems in Philosophy, 2nd ed. (R.A. George, Trans.), Routledge and Kegan Paul, London.
Carruthers P. 1992. Human Knowledge and Human Nature: A New Introduction to an Ancient Debate. Oxford University Press, Oxford.
Clark A.J. 1987. The philosophical significance of an evolutionary epistemology. In: Callebaut W. and Pinxten R. (eds), Evolutionary Epistemology: A Multiparadigm Program. Reidel, Dordrecht, Netherlands, pp. 223–244.
Clendinnen F.J. 1989. Evolutionary explanation and the justification of belief. In: Hahlweg K. and Hooker C.A. (eds), Issues in Evolutionary Epistemology. State University of New York Press, Albany, NY, pp. 458–474.
d'Inverno R. 1992. Introducing Einstein's Relativity. Clarendon Press, Oxford.
Darwin C. 1987. Charles Darwin's Notebooks 1836–1844: Geology, Transmutation of Species, Metaphysical Enquiries. Cornell University Press, Ithica, NY.
Dennett D.C. 1991. Consciousness Explained. Little, Brown, New York.
Derksen T. 1993. The Promise of Evolutionary Epistemology. Tilburg University Press, Netherlands.
Descartes R. 1641/1986. Meditations on First Philosophy (J. Cottingham, Trans.). Cambridge University Press, Cambridge.
Gangestad S.W. and Thornhill R. 1997. Human sexual selection and developmental stability. In: Simpson J.A. and Kenrick D.T. (eds), Evolutionary Social Psychology. Erlbaum, Hillsdale, NJ, pp. 169–196.
Godfrey-Smith P. 1996. Complexity and the Function of Mind in Nature. Cambridge University Press, New York.
Goldman A.H. 1990. Natural selection, justification, and inference to the best explanation. In: Rescher N. (ed.), Evolution, Cognition, and Realism: Studies in Evolutionary Epistemology. Lanham, New York, pp. 39–46.
Goldman A.I. 1999. Knowledge in a Social World. Clarendon Press, Oxford.
Guthrie S.E. 1994. Faces in the Clouds: A New Theory of Religion. Oxford University Press, New York.
Hahlweg K. and Hooker C.A. 1989a. Evolutionary epistemology and the philosophy of science. In: Hahlweg K. and Hooker C.A. (eds), Issues in Evolutionary Epistemology. State University of New York Press, Albany, NY, pp. 21–150.
Hahlweg K. and Hooker C.A. 1989b. Issues in Evolutionary Epistemology. State University of New York Press, Albany, NY.
Hamer D.H. 2004. The God Gene: How Faith is Hardwired into our Genes. Randomhouse, London.
Haselton M.G. and Buss D.M. 2000. Error management theory: a new perspective on biases in cross-sex mind reading. J. Personal. Social Psychol. 78: 81–91.
Hume D. 1739/1978. A Treatise of Human Nature. Oxford University Press, Oxford.
Jones D. 1996. An evolutionary perspective on physical attractiveness. Evolut. Anthropol. 5: 97–110.
Joyce R. 2001. The Myth of Morality. Cambridge University Press, Cambridge.
Kahneman D., Slovic P. and Tversky A. (eds) 1982. Judgment under Uncertainty: Heuristics and Biases. Cambridge University Press, Cambridge.
Kaplan S. 1992. Environmental preference in a knowledge-seeking, knowledge-using organism. In: Barkow J.H., Cosmides L. and Tooby J. (eds), The Adapted Mind: Evolutionary Psychology and the Generation of Culture. Oxford University Press, New York, pp. 581–598.
Kornblith H. 1993. Inductive Inference and Its Natural Ground: An Essay in Naturalistic Epistemology. MIT Press, Cambridge, MA.
Krebs D.L. 1998. The evolution of moral behaviors. In: Crawford C.B. and Krebs D.L. (eds), Handbook of Evolutionary Psychology: Ideas, Issues, and Applications. Erlbaum, Mahwah, NJ, pp. 337–368.

Leslie A.M. 1994. ToMM, ToBy, and agency: core architecture and domain specificity. In: Hirschfeld L.A. and Gelman S.A. (eds), Mapping the Mind: Domain Specificity in Cognition and Culture. Cambridge University Press, New York, pp. 119–148.

Lettvin J.Y., Maturana H.R., McCulloch W.S. and Pitts W.H. 1959. What the frog's eye tells the frog's brain. Proc. Inst. Radio Eng. 47: 140–151.

Lorenz K. 1977. Behind the Mirror: A Search for a Natural History of Human Knowledge (R. Taylor, Trans.). Harcourt Brace Jovanovich, New York.

Lorenz K. 1982. Kant's doctrine of the a priori in the light of contemporary biology. In: Plotkin H.C. (ed.), Learning, Development, and Culture: Essays in Evolutionary Epistemology. Wiley, Chichester, UK, pp. 121–143.

McCauley R.M. 2000. The naturalness of religion and the unnaturalness of science. In: Keil F.C. and Wilson R.A. (eds), Explanation and Cognition. MIT Press, Cambridge, MA, pp. 61–85.

Meyers R.G. 1990. Evolution as a ground for realism. In: Rescher N. (ed.), Evolution, Cognition, and Realism: Studies in Evolutionary Epistemology. Lanham, New York, pp. 111–118.

Miller A.A. 1987. The genesis of atomic physics and the biography of ideas. In: Callebaut W. and Pinxten R. (eds), Evolutionary Epistemology: A Multiparadigm Program. Reidel, Dordrecht, Netherlands, pp. 267–281.

Mithen S.J. 1996. The Prehistory of the Mind: The Cognitive Origins of Art, Religion, and Science. Thames and Hudson, London.

Nerlich G. 1994. The Shape of Space, 2nd ed. Cambridge University Press, Cambridge.

Nozick R. 1993. The Nature of Rationality. Princeton University Press, Princeton, NJ.

Nozick R. 2001. Invariances: The Structure of the Objective World. Belknap Press, Cambridge, MA.

O'Hear A. 1997. Beyond Evolution: Human Nature and the Limits of Evolutionary Explanation. Clarendon Press, Oxford.

Orians G.H. and Heerwagen J.H. 1992. Evolved responses to landscapes. In: Barkow J.H., Cosmides L. and Tooby J. (eds), The Adapted Mind: Evolutionary Psychology and the Generation of Culture. Oxford University Press, New York, pp. 555–579.

Petrinovich L., O'Neill P. and Jorgensen M. 1993. An empirical study of moral intuitions: toward an evolutionary ethics. J. Personal. Social Psychol. 64: 467–478.

Putnam H. 1983. Realism and Reason. Cambridge University Press, Cambridge.

Quine W.V. 1969. Ontological Relativity, and Other Essays. Columbia University Press, New York.

Quine W.V. 1975. The nature of natural knowledge. In: Guttenplan S. (ed.), Mind and Language: Wolfson College Lectures. Clarendon Press, Oxford, pp. 67–81.

Resnick L.B. 1994. Situated rationalism: biological and social preparation for learning. In: Hirschfeld L.A. and Gelman S.A. (eds), Mapping the Mind: Domain Specificity in Cognition and Culture. Cambridge University Press, New York, pp. 474–493.

Rorty R. 1979. Philosophy and the Mirror of Nature. Princeton University Press, Princeton.

Ruse M. 1986. Taking Darwin Seriously: A Naturalistic Approach to Philosophy. Blackwell, Oxford.

Ruse M. 1990. Does evolutionary epistemology imply realism? In: Rescher N. (ed.), Evolution, Cognition, and Realism: Studies in Evolutionary Epistemology. Lanham, New York, pp. 101–110.

Shackelford T.K. and Larsen R.J. 1997. Facial asymmetry as an indicator of psychological, emotional, and physiological distress. J. Personal. Social Psychol. 72: 456–466.

Shackelford T.K. and Larsen R.J. 1999. Facial attractiveness and physical health. Evolut. Human Behav. 20: 71–76.

Sober E. 1994. From a Biological Point of View: Essays in Evolutionary Philosophy. Cambridge University Press, New York.

Spelke E.S. 1990. Principles of object perception. Cognit. Sci. 14: 29–56.

Stephens C.L. 2001. When is it selectively advantageous to have true beliefs? Sandwiching the better safe than sorry argument. Philos. Stud. 105: 161–189.

Stewart I. and Cohen J. 1997. Figments of Reality: The Evolution of the Curious Mind. Cambridge University Press, Cambridge.
Stewart-Williams S. 2003. Darwin and Descartes' demon: on the possible evolutionary origin of belief in an external world. Evolut. Cognit. 9: 123–130.
Stewart-Williams S. 2004. Darwin meets Socrates: evolutionary psychology and the innate ideas debate. Doctoral dissertation, Massey University.
Stewart-Williams S. and Podd J. in press. Elements of an evolved conceptual framework. In: Fletcher-Flinn C.M. and Haberman G.M. (eds), Cognition, Language, and Development: Perspectives from New Zealand. Australian Academic Press, Bowen Hills, Queensland.
Stich S.P. 1990. The Fragmentation of Reason: Preface to a Pragmatic Theory of Cognitive Evaluation. MIT Press, Cambridge, MA.
Stroud B. 1985. The significance of naturalized epistemology. In: Kornblith H. (ed.), Naturalizing Epistemology. MIT Press, Cambridge, MA, pp. 71–89.
Taylor E.F. and Wheeler J.A. 1992. Spacetime Physics: Introduction to Special Relativity, 2nd ed. Freeman, New York.
Thornhill R. 1998. Darwinian aesthetics. In: Crawford C.B. and Krebs D.L. (eds), Handbook of Evolutionary Psychology: Ideas, Issues, and Applications. Erlbaum, Mahwah, NJ, pp. 543–572.
Trivers R.L. 1971. The evolution of reciprocal altruism. Quart. Rev. Biol. 46: 35–57.
Vollmer G. 1984. Mesocosm and objective knowledge: on problems solved by evolutionary epistemology. In: Wuketits F.M. (ed.), Concepts and Approaches in Evolutionary Epistemology: Toward an Evolutionary Theory of Knowledge. Reidel, Dordrecht, Netherlands, pp. 69–121.
Vollmer G. 1987a. On supposed circularities in an empirically oriented epistemology. In: Radnitzky G. and Bartley W.W. III (eds), Evolutionary Epistemology, Rationality, and the Sociology of Knowledge. Open Court, La Salle, IL, pp. 163–200.
Vollmer G. 1987b. What evolutionary epistemology is not. In: Callebaut W. and Pinxten R. (eds), Evolutionary Epistemology: A Multiparadigm Program. Reidel, Dordrecht, Netherlands, pp. 203–221.
Wilson D.S. 2002. Darwin's Cathedral: Evolution, Religion, and the Nature of Society. University of Chicago Press, Chicago.
Wynne C.D.L. 2001. Animal Cognition: The Mental Lives of Animals. Palgrave, Basingstoke.