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SAMIR OKASHA'S PHILOSOPHY

ESSAY REVIEW OF SAMIR OKASHA'S
AGENTS AND GOALS IN EVOLUTION,
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This essay offers some reflections on Samir Okasha's new monograph *Agents and Goals in Evolution*, his style of doing philosophy, and the broader philosophy of nature project of trying to make sense of agency and rationality as natural phenomena.

Keywords: agency, evolutionary biology, Samir Okasha.

In popular culture, evolution is often understood as something like an agent: 'mother nature' is described as 'choosing' the best traits and 'discarding' the worst. The behaviour of other animals is likewise often described in terms of their interests, strategies, and goals. Emperor penguins (*Aptenodytes forsteri*) are described as huddling *in order to* stay collectively warm. The European honeybee (*Apis mellifera*) uses a waggle dance because it *wants* to communicate information to others in the hive. And the behaviour of chimpanzees (*Pan troglodytes*) is compared to human *strategizing* over mates, resources, and their position in social hierarchies and networks. One need go no further than a David Attenborough documentary to see the abundance of this intentional language in our folk understanding of biology. In 2018, Samir Okasha finally released his long-awaited book *Agents and Goals in Evolution* [henceforth *Agents and Goals*] with Oxford University Press – a book aimed at addressing the status of these puzzling, yet strangely successful, intentional idioms.

Many non-biologists may be surprised to find that evolutionary biologists frequently engage in this talk of reasons, strategies, goals and wants at levels where we would usually deny the existence of a mind, such as groups or genes. Indeed, evolutionary biologists readily admit that scientists – including many of their colleagues within the biological sciences – find their tendency to use such agential language 'unnerving, if not downright embarrassing' (Ågren 2020, p. 266). It is seen as dangerous and unhelpful *anthropomorphism* to describe not only animals but also cells, (selfish) genes and even groups as having goals and intentions – the very opposite of a useful metaphor. And yet, evolutionary biologists persist in and even actively encourage the use of this language. Is there a scientific rationale to justify the use of what Peter Godfrey-Smith (2009) once aptly described as *agential thinking*, or is it merely a way of thinking particularly addictive to the human mind, expressing itself as something Richard Francis (2004) called *Darwinian paranoia*?

With admirable precision, clarity and knowledge, Okasha masters a subject-matter balancing act between evolutionary

biology, economics and philosophy that carefully addresses a set of puzzling questions at the intersection of these fields: What does it mean to treat an organism as a 'rational' 'agent' with 'goals' and 'interests'? In economics, this appears to make *sense*, but is there more to it in the biological world than mere metaphor (which is not to say that metaphors can't be useful; see Veit and Ney 2021)? Furthermore, how do these assumptions play out as empirical hypotheses in the apparently adaptationist framework of those who use agential thinking? How does evolutionary optimization relate to optimization in rational choice models? Can fitness maximisation simply be mapped onto the utility maximisation framework of economics?

Okasha's ambitious monograph wrestles with these questions, offering an incredibly rich and condensed work on a set of interdisciplinary questions neither philosophers of economics nor philosophers of biology have previously given much attention to. Indeed, Okasha underplays the role of economics within his book, a choice that appears to be motivated by a reluctance, stemming from a British sense of humility, to overstate his expertise in economics. The book contains three somewhat independent parts. In **Part I**, Okasha discusses the concept of agency and the possible justifications for using agential thinking. **Part II** focuses on the connection between agential thinking and the adaptationist program that has placed the greatest reliance on this mode of thinking. Finally, **Part III** addresses the links between rationality and evolution, fitness and utility, and agency in economics and biology. Time and time again, Okasha puts great care into supporting his arguments and not overstating his conclusions, concluding his monograph with characteristic modesty: 'I hope that there is an element of truth in what I have written, and that the journey has been enjoyable for the reader' (p. 233). But while this humility is commendable, it is also unfortunate since many of the philosophers of economics I know either have not heard of the book or do not consider it relevant to their field. Yet Okasha's monograph contains contributions to the literature on irrational risk preferences, payoff discounting and intransitive choices that would easily find a home in the best journals the philosophy of economics has to offer. Indeed,

Okasha (2012, 2016) previously published two papers in the journal *Economics & Philosophy* urging the combination of insights from biology and economics. This would have made that journal another ideal target for a review of Okasha's book, but they unfortunately – though not unexpectedly – declined to have the book reviewed for the very same reason it would have been valuable there: that it would not be *sufficiently central to their readers' interests*.

Here, I hope that this review essay can at least partially remedy this lack of interest among philosophers of economics in the sort of interdisciplinary work produced by the likes of Samir Okasha, Cedric Paternotte, Alex Rosenberg, Don Ross, Armin Schulz, David Spurrett, Joeri Witteveen, Jack Vromen, myself and a long list of philosophers using evolutionary models such as Rainer Hegselmann, Cailin O'Connor, Hannah Rubin, Brian Skyrms and Kevin Zollman. A conceptual integration of the biological and social sciences, after all, has long been one of the goals of our fields, even if some have maintained that this would not be a very fruitful endeavour (Gintis 2006; Mesoudi 2007; Ross 2007; Hagen et al. 2008; Khalil 2010; Callebaut 2011; Earnshaw 2011; Gayon 2011; Hodgson and Knudsen 2011; Heintz et al. 2011; Nelson 2011; Witt 2011). Instead of providing a detailed analysis of Okasha's new book, which may be impossible due to its breadth and has been partially attempted elsewhere (see discussion below), I will take a higher-level perspective in which I aim to cultivate interest among philosophers of economics in the themes Okasha is addressing and to locate the role of his new book in the larger philosophy of nature project that attempts to naturalise the notions of agency and rationality.

Why is it that the tools of economics often allow us to explain and predict the behaviour and choices of non-human animals more adequately than those of the human targets for which they were originally designed? Bacteria, which have often successfully been described using the tools of evolutionary game theory (see Frey and Reichenbach 2011 for an overview), can hardly be described as mentally engaging in utility maximisation. The British economist and game theorist Ken Binmore – a close collaborator of Okasha's – noted as much:

Maynard Smith's book *Evolution and the Theory of Games* directed game theorists' attention away from their increasingly elaborate definitions of rationality. After all, insects can hardly be said to think at all, and so rationality cannot be so crucial if game theory somehow manages to predict their behaviour under appropriate conditions.

– Ken Binmore, foreword in Weibull (1995, p. x)

The question why such agential models are so successful within both biology and economics is puzzling, since humans similarly cannot be said to satisfy the increasingly elaborate definitions of rationality common in rational choice theory. But neither economics nor the philosophy of economics

appears to have shown much interest in investigating these interdisciplinary questions in detail (see Ross 2005 for an exception).

This is partially surprising since the first contemporary philosopher of economics, Alex Rosenberg (1976), was quite interested in this question and, unlike his contemporaries Dan Hausman (1992) and Uskali Mäki (1992), defended a highly critical view of the status of economics and its idealised rationality assumptions, urging the field to move closer to actual empirical work in psychology, biology and neuroscience. Upon realising that 'economists were not going to take much notice of the work done in the philosophy of economics', Rosenberg left the philosophy of economics in the 1980s after 15 years of work in the field in order 'to work in the philosophy of biology, a subdiscipline in which the cognate scientists have shown more sympathy, interest, and willingness to be influenced by philosophers' (Rosenberg 2009, p. 59). Indeed, without Rosenberg's decision to change fields, this review essay might not have existed. As Okasha himself admits: 'I am also indebted [...] to Alex Rosenberg whose lectures [as a visiting professor at Oxford] initially aroused my interest in philosophy of biology' (Okasha 2006, p. v).

While Rosenberg's highly critical stance on economics didn't gain him many followers in the subsequent development of the philosophy of economics as an independent branch of the philosophy of science, his work underwent a steep increase in attention as a result of the global financial crisis. Re-evaluating his earlier work in the light of his work in the philosophy of biology, Rosenberg (2009) went so far as to argue that economics itself should be seen as a sub-discipline of biology: '[a]lmost everything mysterious and problematical to the empiricist philosopher of science about economics is resolved once we understand economics as a biological science' (p. 59).

The philosophy of *science* of decades past was often a highly abstract and general debate regarding science as a *whole*. This body of work, with the exception of early pioneers such as Popper, has largely been ignored by scientists. With the growth of the field, however, we have seen the development of the philosophies of various special sciences as sub-fields in their own right. But while the philosophers of biology – or economics for that matter – responsible for that development have been concerned with the actual work of these sciences, there has often been a gap between the way philosophers and more theoretically inclined scientists have talked about the philosophical issues of their fields, a gap that only widened as these sub-fields grew and became more established in their own right. Okasha seemed motivated by similar concerns in his *Evolution and the Levels of Selection*, for which he received the Lakatos Award in 2009 – the most prestigious reward our field has to offer. He argued that the growing

gap between theoreticians and philosophers of science is one that should be closed, seeing this as *the* central task of his book. He argued that '[w]ith a few notable exceptions, philosophers' discussions of the levels of selection have not used the language, concepts, and formal techniques used by the biologists themselves' and that this explains why 'most philosophical discussions have not had much impact in biology' (2006, p. 1). To achieve this goal of bridging the fields of theoretical biology and the philosophy of biology, Okasha was willing to become an expert in the mathematical tools and formalisms as well as the conceptual debates of evolutionary biologists. Indeed, he explicitly argued that his book targeted 'evolutionary biologists, philosophers of science, and interested parties from other disciplines' (p. 2). Evolutionary biologists responded kindly to his extreme caution, mathematical rigour and clear conceptual analysis of the levels-of-selection controversy, promptly making this work one of the most cited in the philosophy of biology. As Massimo Pigliucci (2007) rightly predicted in his review of *Evolution and the Levels of Selection*, the book could not be 'ignored by anyone interested in this field for many years to come' (p. 551).

Agents and Goals can be seen simply as a continuation of Okasha's work on the conceptual and theoretical foundations of evolutionary theory. It embodies all the characteristics that made *Evolution and the Levels of Selection* such an important book. It has the same or perhaps even more of the mathematical rigour that inspired the next generation of philosophers of biology such as Jonathan Birch (2013, 2017) and Pierrick Bourrat (2014, forthcoming) to become experts in the mathematical formalisms of practising biologists. A lucid philosophical analysis of the contrast between the agency of evolutionary biology and the agency of economic agents, it is written with such conceptual clarity and elegance that it can be understood by economists, philosophers and biologists alike. Most strikingly, perhaps, it is beautifully characteristic of the detailed knowledge and care that have come to be associated with Okasha's style of philosophy. The book is largely a result of a *European Research Council* grant that Okasha received from 2013–2017 as a Principal Investigator for his 'Darwinism and the Theory of Rational Choice' project and of his earlier 2008–2011 grant from the *Arts and Humanities Research Council* for a project on 'Evolution, Cooperation and Rationality', which culminated in an influential edited volume with Ken Binmore titled *Evolution and Rationality* (Okasha and Binmore 2012). *Agents and Goals* is simply the final synthesis of over 10 years of philosophical engagement with theoretical work in both evolutionary biology and rational choice theory.

It is thus not surprising that since its release, the book has amassed a staggering number of reviews by an illustrious list of philosophers and evolutionary biologists. In their editorial of an issue centred around a review symposium of *Agents*

and *Goals* in the Review journal *Metascience*, Boschiero and Wray (2019) praise Okasha's book as a seminal contribution to both evolutionary biology and philosophy. The issue features reviews by Daniel C. Dennett (2019), evolutionary biologist Andy Gardner (2019) and philosopher/evolutionary game theorist Hannah Rubin (2019), alongside a reply to all three by Okasha (2019). Additional reviews of Okasha's book have been provided by a long list of philosophers of biology such as Jonathan Birch (2019) in *Mind*, Robert A. Wilson (2019) in *Notre Dame Philosophical Reviews*, Philippe Huneman (2020) in *Acta Biotheoretica*, Cailin O'Connor (2020) in *Philosophy of Science* and Adrian Stencel (2020) in *History and Philosophy of the Life Sciences*. Finally, we find an elegant review by evolutionary biologist J. Arvid Ågren (2020) in *The Quarterly Review of Biology*. I have met, or at least been in contact with, all but one of these commentators, which is indicative on the one hand of the interest in Okasha's book but on the other hand of how unfortunately narrow the field of researchers is who are interested in the connection between evolution and rational choice theory.

In this regard, it should be clear why *Agents and Goals* will unfortunately not reach the same status as *Evolution and the Levels of Selection*. Unlike the hard-fought debates over Darwinian individuality, units of selection, kin selection, and group selection, all of which notably spiked shortly after the publication of Okasha's book on the levels of selection, there simply isn't a parallel conflict regarding the use of agential language in evolutionary biology. This is not to say that it is not a good book. In many ways, it embodies all the virtues of Okasha's previous monograph; indeed, in my opinion it surpasses its predecessor. Okasha had the difficult task of living up to the high expectations of the readers of his previous book and in many ways has succeeded in this endeavour. But quality is not the same as impact. Agential thinking is simply not seen as a controversial topic among many of the evolutionary biologists Okasha would like to address, as is emphasized in Gardner's highly critical and somewhat uncharitable review. Nevertheless, I consider *Agents and Goals* a striking example of the importance of philosophy of science for addressing questions practising scientists do not have the time to engage themselves. This is not to say there is no conflict or that there are no differences in opinion on the status of this language, but rather that it is a comparatively minor debate that many practising evolutionary biologists simply ignore (see Tarnita 2017; Veit 2019a). Okasha's goal in *Agents and Goals*, of course, is to argue that this is not the right stance to take and that evolutionary biologists should be more careful in how they use this language. But this isn't quite the same contribution as Okasha's previous monograph. In one case there is a longstanding and theoretically challenging issue that biologists have wrestled with for decades. There, Okasha's work was a welcome contribution since it was largely able to provide conceptual clarity in a previously conceptually muddled debate. In the other, however, Okasha

will inevitably appear to practising scientists as someone who, despite their good intentions, interrupts their work to tell them that they should be more careful how to use their concepts – an activity philosophers of biology have long been engaged in with only marginal success. So, I am highly sceptical of Dennett's prediction that Okasha's book 'might well become the consensus classic text for biologists to fall back on when they find themselves unable to resist both function talk and agent talk in the course of their inquiries and explanations' (2019, p. 355) or that it will turn out like Pigliucci's assessment of his earlier book. Dennett's view seems more motivated by his strongly adaptationist stance, treating natural selection as a universal acid (Dennett 1995), and obviously by the power of his intentional stance, which we've jointly applied elsewhere (Veit et al. 2019). Thanks to Okasha, however, I now fear that these intentional stances may sometimes mislead us when thinking about evolution.

Unlike the concepts of individuality, replicators, units and levels of selection, which are highly contested in evolutionary biology as concepts intended to *capture* scientific phenomena, agential talk is used merely as a heuristic to better understand biological phenomena. The goal of biologists is decidedly not to argue that these biological entities should necessarily be understood as agents, but that it is a useful (perhaps even necessary) way to make progress in our understanding of evolution. This is what Gardner (2019) apparently wants to express in his somewhat backhanded reply to Okasha that 'in science it is the usefulness of a concept, rather than its philosophical tidiness, that provides its ultimate justification' (p. 359). This, of course, is a widely accepted point among philosophers of science – and Okasha is no exception. What matters is how useful this way of thinking is in scientific practice. That particular models, frameworks or concepts are used among scientists is, of course, no proof that they are necessarily useful, and philosophers of science may sometimes need to take a stance that does not simply embrace model anarchism in a sort of anything-goes mentality – though I often think that philosophers err on the wrong side here and should indeed be more pluralist (Veit 2019b, 2020; Veit & Browning 2020).

For a long lineage of British theoretical biologists such as Dawkins, Gardner, Alan Grafen or Maynard Smith, whose 'neo-Paleyan' methodology and academic training is the application of adaptationist thinking, there will naturally be little question that agential thinking *must* be useful (see Gardner 2017; Lewens 2019). Gardner (2019), for instance, appeals to Fisher's (1930) fundamental theorem of natural selection as something like a lawlike proof that 'reveals the identity of the adaptive agent, the individual organism, and pinpoints her agenda, maximization of her fitness' (p. 361). To which Okasha (2019) elegantly retorts that Gardner is 'guilty of reading his own [']agenda['] into Fisher' (p. 378). Indeed, Gardner merely shows that agential thinking is *built*

into the practice of many evolutionary biologists. Hiding behind his characterisation of Okasha as a 'philosopher' by suggesting the 'empirical to be outwith his purview', whereas his own justification is, quote, '*scientific*' in nature (p. 362), obscures the fact that it is Gardner – not Okasha – who relies on *a priori* arguments for the legitimacy of agential thinking. Okasha's book shows that it is right to question whether this mode of thinking is necessary and helpful or merely unquestioned dogma.

In his quest to address this problem, Okasha distinguishes between two different kinds of agential thinking. *Type 1* treats organisms as goal-directed agents – rational agents designed to maximise their own fitness. *Type 2* treats the process of natural selection as itself an agent. I agree with Okasha's careful conclusion that agential thinking of type 2 is probably more harmful than useful, rightly criticising Darwin, who likewise felt unease about his talk of nature as something like an agent. It is not a necessary ingredient for making sense of evolutionary phenomena, even if helpful as a heuristic learning tool. Too often has it led to misleading views of natural selection as itself being a goal-directed process (though see Rubin (2019) for a defence of type-2 thinking). Type-1 thinking, on the other hand, can often be useful, which raises the question of why this is so. What makes agential thinking of this type so successful in understanding evolution? Discussing a variety of philosophical options, Okasha draws on discussions of intentional-state attributions to other humans to argue that it is *unity of purpose* that makes agential explanations successful: 'the organism's traits must have evolved because of their contribution to a *single* overall goal, so have complementary rather than antagonistic functions. To the extent that this is not so, it ceases to be possible to think of the organism as agent-like' (p. 230).

Both Gardner (2019) and Stencel (2020) argue that the book would benefit from more of a discussion of the connection between agential thinking and evolutionary disputes over the levels of selection and the location of Darwinian individuals as well as a discussion of more biological examples. But *Agents and Goals* is already an incredibly rich book. One immediately notices that Okasha tried to fit as much novel content into his book as possible, leaving much of the content from his previous papers on the connection between rationality and evolution in footnotes, rather than merely presenting us with a collection of papers. This can only be recommended – doubly so because it appears to have become increasingly rare for scholars of Okasha's reputation. So, I would encourage readers of his book to seek out additional papers Okasha has written rather than treat the book as a mere summary of his work (see for instance Okasha 2013; Okasha & Paternotte 2014).

I fear, however, that Okasha's analysis may have given an impression of the sorts of purely conceptual investigations

that are now often criticised among philosophers of science: too much focus given to the internal coherence of a concept rather than to how it is used in practice. Indeed, Okasha's philosophy is of a peculiar sort because it embraces the style of an older tradition. In his *Evolution and the Levels of Selection*, for instance, Okasha describes himself as a 'conservative' treating clarification of scientific concepts as the core of his understanding of the purpose of philosophy of science, thus assuming 'a fairly sharp distinction between empirical and conceptual questions, an unfashionable view in some quarters' (2006, p. 2). Despite this, Okasha's work is celebrated across our discipline (as well as in evolutionary biology) as some of the best work the philosophy of biology has to offer. And for good reason. Firstly, Okasha has achieved mastery of the tools of conceptual analysis, single-handedly proving that this more traditional style of doing philosophy of science still has a useful role to play if done well. Secondly, Okasha has developed an intricate knowledge of both the philosophical and the scientific literature despite the fact that each has grown exponentially (and the two have grown exponentially apart). Okasha, in a way, writes for those who are already familiar with the empirical work of the sciences and is extremely cautious not to misrepresent their work. I thus think that Gardner's and Stencel's respective criticisms are both largely misplaced. Okasha's suggestion to focus on the unity of purpose is obviously influenced by his earlier work on the levels of selection. To have a conflict of interest between a gene and the organism is both a conflict between two levels of selection and a conflict between two levels of agency. Okasha offers a causal account that attributes agency as something that comes in degrees and explains *why* agential thinking is successful by capturing the shared evolutionary fate of multicellular arrangements. Once we explicate these implicitly empirical premises of Okasha's account by linking it to work in experimental evolutionary biology, we can turn his suggestion 'that once we have identified the relevant level of selection/adaptation in any particular case, this will immediately yield the right candidate for the role of agent, if we wish to apply agential thinking' (p. 43) into an argument supported by empirical work. When agency is explicitly built into theoretical models, it seems hard to deny that this could be harmful rather than a mere idealisation. But just as in economics, it is an open question whether and where the kind of optimising agency can be found in nature that would make agential thinking useful for understanding actual biological target systems. The application of models to this empirical work is a different matter altogether, appearing to function as a form of 'plumbing' (Veit 2021). Indeed, often it is only after doing an enormous amount of empirical work that we have understood how selection has shaped 'super-organisms', such as beehives, that make it useful to think of the group as an agent (see also Tarnita 2017). The empirical work comes first – the agential description only later, once we've understood the units of selection. This is why Tarnita (2017) urges empirical research largely to omit loaded language in

order to approach these target systems with a certain sense of theoretical neutrality. Once we have understood them, however, it may be useful to treat them in agential terms. The justification for agential thinking, as Okasha points out, should thus ultimately be *empirical*, not a priori.

This brief overview has left out many of the details and much of the nuance in Okasha's discussion, but it offers an insight into the main arguments Okasha makes in Part I on agency in evolutionary biology and Part II on agency and fitness-maximisation. The third and final part of *Agents and Goals* finally addresses the topic I was most interested in: the connection between the maximisation models of economics and those of evolutionary biology. In many ways, this is where I see the greatest potential for philosophical contributions: drawing connections between different fields, bringing empirical evidence together and building a single connected picture of the world. Godfrey-Smith (2013) emphasizes the importance of this work in philosophy with a comment attributed to Richard Rorty, who noted that philosophy is in a unique position as the only 'place in the university where a student can bring any two books from the library and ask what, if anything, they have to do with each other' (p. 4). But conceptual analysis alone can get us only so far in achieving this goal. This is unfortunate because the discussion starts out strong, examining the hypothesis that adaptive behavioural plasticity could be a precursor to proto-rationality in non-human animals. However, it then quickly dives into a discussion of various concepts of rationality. While Okasha's discussion usefully distinguishes between rationality as an evolutionary product and rationality as a concept, model or heuristic tool for thinking about evolution, relatively little time is spent on how these concepts would help us explain the evolution of agency – how they would enable us to understand the messy and complex nature of agency in nature.

Here, we find a rich and still developing interdisciplinary literature without any stable concepts or consensus. This is not the same kind of conflict that would benefit from the sort of conceptual analysis that made *Evolution and the Levels of Selection* so successful. Economists justifying their models by recourse to evolutionary biology, and evolutionary biologists doing the same through recourse to rational choice models, simply do not care very much about whether their models and modes of explanations fit perfectly. It is thus not surprising that Okasha provides us with an elegant demonstration in Chapter 7 of the many ways these two forms of rationality can come apart. Indeed, Okasha's discussion of behavioural ecology and ecological rationality nicely demonstrates that neither evolutionary biologists nor economists can ignore the mechanisms – both evolutionary and cognitive – that make agential explanations work in practice. Merely asserting a link to a different discipline in which the same mode of thinking is used can no longer be considered enough to justify the use of

agential thinking. This I see as the greatest accomplishment of *Agents and Goals*. Okasha has made astounding progress on many of the questions that have puzzled me since my days as an undergraduate in philosophy and economics but were relegated to niche discussions. The thorough treatment Okasha offers of the close connections and differences between the two utility-maximising paradigms offers the best discussion of this topic – so far – in the extant literature. And I hope that others in the philosophy of economics will become interested in engaging with the exciting interdisciplinary problems Okasha has exposed.

After so much praise, I shall conclude my essay review with a more critical point of view that targets Okasha's very style of doing philosophy. By exploring the concepts of fitness, utility and rationality in such depth, he leaves little space for talking about the evolution of rationality. Indeed, despite providing us once again with an A-game in what traditional philosophy has to offer, Okasha's work also reflects the inevitable trade-offs inherent in this style of work. What is needed in *this debate* is an entirely different style of philosophy – represented in the work of Dennett, Godfrey-Smith, Ross, Spurrett, and Sterelny – that can hardly be described as the careful conceptual analysis found in Okasha and is often much closer to the sort of messy and speculative science found at the emergence of new research programs. What they are doing has been described as integrative philosophy of science, naturalist philosophy, synthetic philosophy or philosophy of nature.

They are drawing together empirical results and theoretical models from a number of different sciences to explain the evolution of agency, even if their explanations are mere sketches to be worked out by future empirical research. This is clearly different from Okasha's work, which has deliberately shied away from 'speculating about empirical matters on which there isn't much data yet' [from personal conversation], which is not to say that *Agents and Goals* doesn't make contributions to this more scientific project. In practice, there often isn't a very sharp boundary between conceptual and empirical work providing multiple points of contact, even when one conceives their own work as purely conceptual. Okasha, for instance, draws on more speculative work by Godfrey-Smith (1996) and Sterelny (2003) for a possible explanation of the evolution of behavioural flexibility and rational decision-making as a response to environmental complexity. But in order to understand how actual decision-makers evolve in nature, we will have to engage with a much more fluid, messy and gradualist conceptual framework that maps onto the soft, wet and complex reality of agency in nature. Having contributed to this literature myself (Veit & Spurrett 2021; Schlaile, Veit & Boudry forthcoming), I must say that this work will of necessity look very different from the contents of *Agents and Goals*. Indeed, Okasha's current and my former institution – the University of Bristol – can

perhaps even be considered the birthplace of this kind of work, with the likes of Ken Binmore, Alasdair Houston, Michael Mendl and John McNamara long challenging us to investigate the actual evolution of decision-making and agency.

But this should not be understood as a criticism of Okasha's excellent book. Quite the opposite, in fact. In many ways, Okasha removes the conceptual stumbling blocks and confusions that have plagued those who sought to unite the insights of economics and biology. Still, more work is to be done. This is why Okasha's urge to caution in the use of agential thinking, while perhaps not influencing evolutionary biology as a whole, will surely leave a mark on the interdisciplinary work of those trying to explain agency and rational decision-making as an evolutionary product. When and why do agents evolve with preferences whose forms make economic explanations successful? To bridge this gap is to naturalise the sense in which Rosenberg described economics as a biological science. For those interested in engaging in this project, Okasha's conceptually clear and careful book will provide the ideal entry point into and foundation for this vast and complex literature. Indeed, perhaps no one could have done this better than Okasha himself, a proof that this style of doing philosophy is not so 'conservative' after all.

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