Samir Okasha's Philosophy

Essay Review of Samir Okasha's
Agents and Goals in Evolution

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Abstract:
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 a natural phenomenon.

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 behavior 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 honey bee (*Apis mellifera*) uses a waggle dance because it *wants* to communicate information to others in the hive. And the behavior of chimpanzees (*Pan troglodytes*) is compared to human-like *strategizing* over mates, resources, and their position in social hierarchies and networks. One has to go no further than to turn to a documentary of David Attenborough 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, intended to address 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 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 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 balancing act between the subject matter of evolutionary biology, economics, and philosophy to carefully address 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 a 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-maximization simply be mapped unto the utility maximization 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, which appears to be motivated by a British sense of humility not to overstate his expertise in economics. The book contains three somewhat independent parts. In **Part I**, Okasha discusses the concept of agency and the possibly justifications for using agential thinking. **Part II** focuses on the connection between agential thinking and the adaptationist program that has relied on this mode of thinking the most. Finally, **Part III** addresses the link between rationality and evolution, fitness and utility, and to some extent – though I would have liked to see more on this - the evolution of agency. Time and time again, Okasha puts much care into supporting his arguments and not to overstate his conclusions, concluding his monograph characteristically modest: "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 of relevance 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 their 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 for a combination of insights from both 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, Alex Rosenberg, Joeri Witteveen, Cedric Paternotte, David Spurrett, Don Ross, Jack Vromen, Armin Schulz, myself, and a long list of philosophers using evolutionary models such as Rainer Hegselmann, Brian Skyrms, Cailin O'Connor, Kevin Zollman, and Hannah Rubin. A conceptual integration between the biological and social sciences, after all, has long been one of the goals of our fields, even if some maintained that this would not be a very fruitful endeavor (Gintis 2006; Ross 2007; Mesoudi 2007; Hagen et al. 2008; Khalil 2010; Hodgson and Knudsen 2011; Callebaut 2011; Gayon 2011; Nelson 2011; Heintz et al. 2011; Earnshaw 2011; Witt 2011). Instead of providing a detailed analysis of Okasha's new book, which may be impossible due to its breath and has been partially attempted elsewhere (see discussion below), I will take a higher-level perspective in which I aim to make philosophers of economics more interested in the themes Okasha is addressing and locate the role of his new book for the larger philosophy of nature project that attempts to naturalize the notions of agency and rationality.

Why is it that we can often explain and predict the behavior and choice of non-human animals more adequately with the tools of economics than the human targets for which they've been originally designed? Bacteria, who have often successfully been described with the tools of evolutionary game theory (see Frey and Reichenbach 2011 for an overview), can hardly be described as mentally engaging in utility-maximization. The British economist and game theorist Ken Binmore - a close collaborator of Okasha - 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 behavior under appropriate conditions.
>
> – Ken Binmore, foreword in Weibull (1995, p. x)

The question of why such agential models are so successful both within 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 appeared to show 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 idealized rationality assumptions, urging the field to move closer to actual empirical work in psychology, biology, and neuroscience. Rosenberg left the philosophy of economics in the 1980s after 15 years of work in the field due to his realization that "economists were not going to take much notice of the work done in the philosophy of economics" and in order to "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 may not even exist. 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. Reevaluating his earlier work in the light of his work in the philosophy of biology, Rosenberg (2009) now went as 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).

Philosophy of *science* of decades past was often a highly abstract and general debate regarding science as a *whole*. This body of work has largely been ignored by scientists with the exceptions of early pioneers such as Popper. With the growth of the field, however, we've seen the development of a philosophy of the special sciences as sub-fields in their own right. But while these philosophers of biology - or economics for that matter - 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 later 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" thus explaining 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 of evolutionary biologists and not just their conceptual debates. Indeed, he explicitly argued that his book is targeted at "evolutionary biologists, philosophers of science, and interested parties from other disciplines" (p. 2). Evolutionary biologists kindly responded to his extreme caution, mathematical rigour, and clear conceptual analysis on the levels of selections controversy, making it promptly one of the most cited works 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 mathematical rigour (perhaps even more so), 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 practicing biologists. It is lucid and written with such conceptual clarity and elegance to provide a philosophical analysis of the contrast between the agency of evolutionary biology and the agency of economic agents, that can be understood by economists, philosophers, and biologists alike. Most strikingly perhaps, it is beautifully characteristic of the detailed knowledge and carefulness that has 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 as a Principal Investigator for his project "Darwinism and the Theory of Rational Choice project", lasting from 2013 and 2017 and earlier grant from the *Arts and Humanities Research Council* on "Evolution, Cooperation and Rationality" from 2008 to 2011 that culminated in an influential edited volume with the aforementioned 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 it was released, the book has amassed a staggering number of reviews, by an illustrious list of philosophers and evolutionary biologists. In their editorial of an issue centered 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, featuring a review by Daniel C. Dennett (2019), the evolutionary biologist Andy Gardner (2019), and the philosopher/evolutionary game theorist Hannah Rubin (2019), alongside a reply by 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 Cailin O'Connor (2020) in *Philosophy of Science*, Philippe Huneman

(2020) in *Acta Biotheoretica*, Adrian Stencel (2020) in *History and Philosophy of the Life Sciences*, Robert A. Wilson (2019) in *Notre Dame Philosophical Reviews*, and Jonathan Birch (2019) in *Mind*. Finally, we find an elegant review by the evolutionary biologist J. Arvid Ågren (2020) in *The Quarterly Review of Biology*. I have met, or at least been in contact with, all except one of these commentators, which on the one hand is indicative of the interest in Okasha's book, but also of how unfortunately narrow the field is 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 of *Evolution and the Levels of Selection*. Unlike the hard-fought debates over Darwinian individuality, units of selection, kin selection, and the group selection controversy that notably spiked shortly after its publication, 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 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 endeavor. 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 to address questions practicing scientists do not have the time to engage in themselves. This is not to say there isn't any 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 practicing 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 hold and that 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 practicing scientists as someone who, despite their good intentions, interrupts their work in order to tell them that they should be more careful how to use their concepts - an activity philosophers of biology have long been engaged in and have only been marginally successful at. So, I am highly skeptical 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) will turn out like Pigliucci's. Dennett's view seems more

motivated by his strongly adaptationist stance treating natural selection as a universal acid (Dennett 1995) and obviously the power of his intentional stance that we've jointly applied elsewhere (Veit et al. 2019). Thanks to Okasha, however, I now fear it may sometimes mislead us when thinking about evolution.

Unlike the concepts of individuality, replicators, units, and levels of selection that are highly contested in evolutionary biology as concepts intended to *capture* scientific phenomena, agential talk is merely used 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 with 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 doesn't just 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, Maynard Smith, Gardner, or Alan Grafen, 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 law-like 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 characterization of Okasha as a 'philosopher' by suggesting that the "empirical to be out with 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 maximize their own fitness. *Type 2* treats the process of

natural selection itself as an agent. I agree with Okasha's careful conclusion that agential thinking of type 2 is probably more harmful than useful, rightly criticizing 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 itself being a goal-directed process (though see Rubin (2019) for a defense 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 others 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 between the connection of 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 criticized among philosophers of science: too much focus given to the internal coherence of a concept, rather than 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 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 (in addition to evolutionary biology) as among the best work the philosophy of biology has to offer. And for good reason. Firstly, Okasha has achieved mastery over the tools of conceptual analysis, single-handedly proving that this more traditional style of doing philosophy of science is not to be counted out. Secondly, Okasha has developed an

intricate knowledge of both the philosophical and scientific literature despite the fact that each has exponentially grown (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 both Gardners' and Stencel's respective criticisms are 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. It is 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. 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 they could be harmful, rather than a mere idealization. But just like in economics, it is an open question where and whether such optimizing agency can be found in nature that would make agential thinking useful to understand actual biological target systems. The application of models to this empirical work is a different matter altogether appearing like a form of 'plumbing' (Veit 2021). Indeed, often it is only after we have done an enormous amount of empirical work that we have understood how selection has shaped 'super-organisms', such as a beehive that make it useful to think of the group as an agent (see also Tarnita 2017). The empirical work comes first - the agential description later only once we've understood the units of selection. This is why Tarnita (2017) urges empirical research to largely 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 nuance in Okasha's discussion, but it offers an elegant insight into the main arguments Okasha makes in Part I on agency in evolutionary biology and Part II on agency and fitness-maximization. The third and final part of *Agents and Goals* finally addresses the topic I was most interested in: the connection between the maximization models of economics and 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 one 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 behavioral plasticity could be a precursor to proto-rationality in non-human animals, but 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 to think about evolution, relatively little time is spent on how these concepts would help us to explain the evolution of agency - more so 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 has 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 all too 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 behavioral 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 if 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 more niche discussions. The thorough treatment Okasha offers of the close connections and differences between the two utility maximizing paradigms offers the - so far - best discussion of this topic 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 is targeted at Okasha's very style of doing philosophy.

By going into such depth into the concepts of fitness, utility, and rationality, however, little space is left to talk about the evolution of rationality. Indeed, despite providing us once again with the A-game traditional philosophy has to offer, Okasha also presents the inevitable trade-offs inherent to this style of work. What is needed in *this debate* is an entirely different style of philosophy - represented in the work of Dennett, Sterelny, Godfrey-Smith, Ross, and Spurrett - 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 be future empirical work. This is clearly different from Okasha's work that 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 providing multiple points of contact. Okasha, for instance, draws on Godfrey-Smith (1996) and Sterelny (2003) more speculative work as a possible explanation for the evolution of behavioral 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 by necessity look very different than 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 for this kind of work, with the likes of Michael Mendl, Ken Binmore, John McNamara, and Alasdair Houston 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. But more work is to be done. This is why Okasha's urge to use 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 that have the forms of preferences that make economic explanations successful? Bridging this gap is to naturalize 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 and foundation into 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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