Design versus Naturalist Origin Theories of Animal Algorithms

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Robert Marks:

Greetings, I am your ever diligent host for this podcast Robert J. Marks. Naturalism has a rough time explaining some of the incredible properties of the world in which we live. In biology, irreducible complexity is an example, how do we explain complexity that fails when a single component of a complex biological system is removed. It's kind of like the game of Jenga where removal of any single block in the stack sends the whole stack of blocks just crashing down.

Robert Marks:

Similarly, how do these interdependent components of biology that we see and observe every day combine themselves into a single complex system, an irreducibly complex system. There are other biological features that naturalists have a difficult time with. They have a difficult time explaining them. Our guest today, Eric Cassell has added another important item to this list, specifically animal algorithms.

Robert Marks:

To survive and flourish animals follow algorithms. Algorithms are step by step procedures to accomplish something. All computer programs follow algorithms. Animals are pre-programmed to follow algorithms. They are born with these algorithms in their heads, if insects have heads, I guess they do. In his new book, Animal Algorithms Eric asks where do all these algorithms embedded in animals come from? And that's what we're going to talk about today. Eric, welcome.

Eric Cassell:

Thanks again, Bob. Good to be with you.

Robert Marks:

Yeah, Eric, I got to tell you, I did like your book, so it's fun to talk to you about it and dig deeper into some of these topics. Look, to write an algorithm there has to be a foundation of information on which to build. What is the source of that information in animal algorithms?

Eric Cassell:

So, that's the sort of fundamental question about this particular topic. There's a general problem with evolutionary theory in trying to explain the origin of information. As we know, there's a lot of information that goes into, for example, building and developing an individual animal or other type of organism. So the information for example, includes how do you build the body? How do you construct the brain of an animal? Things like that. So there's a lot of information involved in all of that and there's been a lot of research that's gone into those kinds of aspects of animal development. The aspect that I'm addressing more specifically has to do with the behaviors they're the subject of the book. And this particular aspect actually has, I believe a little bit more of a challenge than maybe the physical development of an organism, because as you indicate what we're talking about here are actually algorithms that control the behavior.

Eric Cassell:

And as we talked about in the previous podcast, many of these algorithms are quite sophisticated and obviously involve a lot of information that is embedded within the animal in some way, and actually is used by the animal in controlling these behaviors. So again, the question is where does this information come from? The process of standard or winning an evolution again is one of random variation, mutations and natural selection, but there's been a lot of work done that show that that in fact is a inadequate explanation for the origin of this kind of information.

Eric Cassell:

There's a concept called There's No Free Lunch Theorem that William Dembski has talked about and written about quite a bit. And his research and analysis has shown how it's really difficult or near impossible to generate new information through these rich purely random kinds of processes. A lot of good information and analysis of that topic is contained in a book called Evolutionary Informatics.

Robert Marks:

Yeah. Which is a great book. Yes.

Eric Cassell:

I agree. And since you were one of the co-authors of that book, I'd ask you to maybe explain that a little bit more.

Robert Marks:

Well, let me talk about No Free Lunch, there was an astonishing paper published in 1997 by Wolpert and Macready and it was published in the IEEE Transactions on Evolutionary Programming. And Wolpert and Macready kind of... They toppled a big area in design. It used to be... Well, if you think about it design itself is an iterative process. I like to use things like WD-40. Why do they call it WD-40? It's called WD-40 because it took 40 tries for the industrial chemist to come up with the final solution. Same thing with Formula 409. Formula 409 took 409 experiments before they got it right. So design is search and you have to bring expertise into the search process, into the design process. If the people doing WD-40, I think the guy's name was Larson if he hadn't been an industrial chemist and they had given this problem to somebody with no domain expertise like I don't know, high school chemistry student we would be using not WD-40, but WD-1,263,000. It's just that domain expertise is incredibly important in design.

Robert Marks:

Anyway, getting back to Wolpert and Macready's original paper, 1997. They called it the No Free Lunch. They weren't the inventors of it, but they were certainly the popularizer of it. But they came up with this idea that if you have no domain expertise, if you don't know what you're talking about, that one technique of searching, of doing the design is as good as any other. This is just astonishing. And this means that if you do just random search, random search is blind search where you know nothing that's as good as any other search on average.

Robert Marks:

There's a movie called UHF that starred Weird Al Yankovic. He was the only star of it and there's this one short scene where a blind man, we know he is blind because he's sitting on a park bench with dark glasses and a cane and he has a Rubik's cube and there's a sighted guy next to him. And the blind guy gives a little twist to the Rubik's cube and shows it to the other guy and he says, "Is this it?" And the sighted guy looks at it and he says, "Nope." And then the blind guy gives it another twist and he looks at it and the sighted guy looks at it and he says, "Is this it?" And the guy says, "Nope. That is an example of blind search and the fact that they used a blind man to do it is very appropriate.

Robert Marks:

And in order to get a result, in order to get a design, you can't use blind search. It just takes too long. That's the reason that the blind guy is never, ever going to solve that Rubik's cube by just saying, is this it? No, is this it? No. He has to have some sort of domain expertise to figure out what that Rubik's cube is going to do. And so in every design that we see and that includes insect algorithms and other things, there has to be an infusion of a designer with domain expertise in order to guide the process. Even in the Darwinian example where you have the repeated steps of survival of the fittest, repopulation and mutation over and over and over again. Think of the survival of the fittest, what determines who is fit and who is not? And that has to come even in an evolutionary sort of way of that has to come for an expert.

Robert Marks:

There is a field in electrical engineering called evolutionary programming and people use evolutionary algorithms to do this. But the way they do it is they put a lot of domain expertise into figuring out what the fitness is in order to guide the solution teleologically to the final result. And so when we see incredible designs that Eric Cassell is talking about in insect swarms, and just in general, in animal algorithms, we have to address the question, where did it come from? It can't have just originated by random chance. You can't have, is this it? No. Is this it? No. Is this a good social algorithm? Social swarm algorithm? No, you can't do that. You have to have domain expertise and this is the evidence for design. And both Eric and I have degrees in electrical engineering. We have designed stuff and we know design when we see it and you have to have that domain expertise in order to have sophisticated design. So Eric how'd I do?

Eric Cassell:

That was a great explanation. I appreciate that and I really like your analogy of the Rubik's cube. That's a really good analogy.

Robert Marks:

I do use that little clip in some of the talks that I get, the guy is saying, "Is this it?" "No." "Is this it?" "No." And the guy's going to be there forever. So you mentioned that many of these algorithms that you're talking about in terms of social insects and animals in general, they're pretty complex and they're analogous to computer software programs. Imagine writing a computer software program to do something, you type something randomly on the keyboard you hit run and when you hit run, you ask is this it? No, this isn't the algorithm. So you type something else, which is random. And then you hit the key and you say, is this it? No, it isn't. It'll take you one heck of a long time to come up with the algorithm to do anything using that process, using no domain expertise. You have to know what you're doing. You have to figure out your expertise and you have to incorporate that expertise, that information into the algorithm. So, what do you think about all this, Eric in terms of animal algorithms? I guess you're saying it applies there too.

Eric Cassell:

Yeah, exactly. And I think it's directly analogous. And I think there's actually two problems. One is the development of the algorithm, as you indicate. Just trying to develop an algorithm or a similar computer software program in such a manner. For those of us that have written computer programs I mean, it seems almost impossible you could ever even do that, particularly for something that's highly complex. But the other aspect of it, of I think gets overlooked is the fact that even if you actually are able and somehow to start off with a functioning algorithm or program, if you have all of these random variations or mutations going on in the genome, well, almost always, whenever you have a mutation it's going to degrade the algorithm. It's not going to provide improved functionality or some new functionality.

Eric Cassell:

And it's almost inevitable that it actually degrades the algorithm. And that's actually, what has been found when scientists research mutations in genetics, is that for the most part, these mutations actually degrade in some cases it's proteins or whatever the gene functionality might be. It's more degradatory than helping. And so that is really a major problem for things like these algorithms that control behaviors, because let's just take an example. In the case of, again, these large social colonies of insects that involve a number of algorithms and a number of different aspects of behavior, if you have some random mutations going on and the algorithm gets changed, in other words, the behaviors get changed. Well, it's much more likely than not that such a change is going to be degradatory to the colony because the animals would be engaging in behaviors that are either the wrong behaviors or the behaviors at the wrong time.

Eric Cassell:

In other words, let's just take one case. Something changed about when the animals, let's say honeybees go out to forage for food. Well, if something changes in that algorithm and the honeybees fail to go forage for the food, the colony is going to die. And so that's why I'm saying and more often than not some kind of a process where you're having these random mutations and the algorithm ends up changing in some way, much more often than not that's going to be detrimental to the colony.

Eric Cassell:

Again, that's something that's hard to square with a process that involves some random process and selection and presuming that that's going to result in optimization. Well, in some cases, maybe there's certain aspects of it that might do that, where if there's some kind of a change in the algorithm or the behavior, that's detrimental maybe in some cases that gets selected out. But for the most part, they're not beneficial and it's hard to see how such a process can actually result in optimization of these behaviors or algorithms.

Robert Marks:

We see, for example, the lofting of the importance of mutation in the process of Darwinian evolution, but you do not see pregnant mothers lining up at the doctors and saying, "Will you please mutate my baby?" That is not something which is going to happen. So, you have to bring it down to practical application. Also, what you're talking about is a topic which is covered, I believe in Michael Behe's new book, which is Darwin Devolves, which is that we're not getting better and better we're getting worse.

And this was a premise which was put forward by John Sanford earlier in his book, Genetic Entropy, which says that the genome is getting more and more random. And we see more inheritable diseases today and inheritable conditions today than we ever have, because we're keeping on mutating and we're devolving just exactly like you're saying, Eric.

Eric Cassell:

Yeah. And that's right. That's, to me, one of the major takeaways from Behe's research where it's showing that even in some cases where there aren't genetic changes going on or mutations, and in some cases they might be beneficial to an organism in the short term, in fact, the benefit comes from a gene that's broken. It actually, it's a broken gene that in some ways they may result in something beneficial to the animal, but really it's because the gene broke not because it actually improved the gene or improve the overall genome in some way, or develop some new characteristic. That's not what goes on for the most part.

Robert Marks:

Okay. Let's talk about another aspect of animal algorithms and that's a concept named Convergence. I'm familiar with Simon Conway Morris's pioneering work in the concept of convergence in the history of animal development. Talk about convergence as it applies to animal algorithms?

Eric Cassell:

So, yeah, convergence is this term that evolutionary theorists apply to characteristics that appear in animals that are actually unrelated. In other words, there's no common ancestry. So it could be some physical characteristic where in cases, what I'm talking about are largely behaviors that appear in animals that have no direct ancestry relationship. And so that does present a problem for our win in evolution, being that, how does such a characteristic appear in these different groups of species that are not related in any way? So there's a problem of, okay, if it's a low probability event of these genetic changes occurring in the first place, what's the likelihood of them happening in completely unrelated populations or species?

Eric Cassell:

So that's been a problem for evolutionary theory and one of the explanations that's been used in some cases and it does make some sense is in this part of evolutionary theory called Evo-Devo, where a good example might be certain physical characteristics like for example, bird wing design, we know that there's based on research that was done in developing airplanes. We know there's a lot of constraints in how you construct a wing. So, that actually constrains how those wings could be designed in birds. So the idea that is that in the process of evolution, because of these constraints when you have birds developing wings with certain characteristics and these bird populations or species are completely unrelated. Well, it may be because there's these physical constraints in how design can even occur in the first place or be functional.

Eric Cassell:

So that's somewhat of a plausible explanation that you could apply to things like that, the same idea would apply to, for example, fish fins. That does actually not work for many of the things that I've addressed in the book. For example, these navigation systems or sensors that animals employ, the different kinds of compasses, for example, and other kinds of navigation sensors. They really aren't the same kind of physical design constraints or reasons why an animal would develop a certain kind of navigation sensor. That analogy just doesn't work for example, with bird wings.\ That means that these designs that are used for navigation for example, are really kind of contingent. They're not deterministic. There's nothing driving a certain kind of design or that even the use of a certain sensor.

Eric Cassell:

And as we've seen animals employ a number of different kinds of sensors in different ways. And some animals use one sensor, two sensors, three sensors, and other animals use others. But there's a lot of commonality that appear in animals again, that are completely unrelated, no common ancestry, but they're using similar kinds of navigation sensors, and systems. So again, that begs the question, where does that come from? Why would that even be the case? My thesis is it's a more plausible explanation that there's common design going on rather than some sort of evolutionary explanation based on this notion of convergence.

Eric Cassell:

Same thing applies to, for example, the social behavior where the biggest groups of animals that insects that engage in these social colonies are ants, bees and termites. In many cases, the behaviors of these animals in these colonies are very similar. They're not identical, but there's a lot of commonality in these behaviors. And again, they appear in groups of animals that are completely unrelated, no common ancestry. So how does that occur through an evolutionary process. That's difficult to explain much easier to explain through a common design.

Robert Marks:

Well, this is a problem which is amplified by Simon Conway Morris's work. Now, you're talking about the existence of similar behavior in different species like ants and bees and termites. Simon Conway Morris was looking at the similarity that happens when you have these geographically separated animals. There might be, I don't remember the specifics, but there might be an animal in South America and another one in Japan who have never had the chance of biologically interacting and they have the same sort of DNA, same sort of attributes even though they're geographically separated and couldn't have been in the same evolutionary chain, if you will. So yeah, this enforces that. This is very interesting.

Eric Cassell:

Yeah, exactly.

Robert Marks:

Something interesting in this, you know naturalists they contend that evolution has no goal. That evolution, you're always looking at your toes. Evolution is always looking at your toes, wherein, I think it's more reasonable to assume that there is teleology. That is that there's a goal which is being pursued. Now you addressed this in your book. So let's talk about teleology as related to animal algorithms?

Eric Cassell:

Yeah. So this is sort of... More of a philosophical issue and maybe a higher level issue that arises, particularly with many of the aspects of behaviors that I've been addressing. If you go back into the history of scientists looking at the world, as we see it, particularly organisms and animals. Aristotle had a concept that involved a certain version of teleology. So that was actually kind of a dominant view for quite a long time, until closer to the period of Darwin and development of evolutionary theory. And subsequent to that many of the defenders of the evolutionary view basically assert that the concept of teleology or purpose really shouldn't be part of science and doesn't play a role in explaining this, but I'm thinking of Richard Dawkins, Michael Ruse, Jerry Coyne. People like that, that's the strong point of view that they have. That basically you can't infer purpose or teleology in aspects of, in this case, animal behavior.

Eric Cassell:

I use the term in the book that I refer to the people that take that point of view, they have kind of a teleophobia. Meaning that they have an aversion to admitting that there's an existence of design or final cause in nature, which again, kind of gets back to Aristotles' original theory. But I think when you examine the behaviors that are described in the book, in almost every case you can find that there's a lot of evidence for purpose or goals. So just to take one aspect of this, as an example, again, in these social colonies when you look at particularly the ones that are considered superorganisms, you have a higher level functionality of the colony. There's something that's determining some higher level functionality that then drives all of the individual behaviors that in this case, insects engage in.

Eric Cassell:

So something is setting some higher level goal or purpose and all of the functions that go on within the colony are supporting that higher level goal or purpose. And there's plenty of evidence to say that that's the case and the same thing could be said about many of the other kinds of behaviors that I talk about. That kind of higher level goal or purpose fits more within a design point of view than it does again with the Darwinian view now where the Darwinian evolutionists are saying, "You can't even admit that that's a case. You can't even try to account for the fact that there might be some higher level purpose to these behaviors, because it's just totally contrary to Darwinian evolution. So that's kind of the fundamental problem that's being dealt with.

Robert Marks:

You know, in terms of teleology, when I was learning to drive the first thing my dad told me, he says, "Don't look where you're at. Don't look over the hood, look at where you're going." And that's the only way to drive. I think that most new drivers are told that. Yogi Bear has a great saying he says, "If you don't know where you are going, you will never get there." So this is the problem with teleology and having a goal being defined as opposed to just looking at your toes all of the time.

Eric Cassell:

And the other thing, just to pick up on that, that is interesting to me as an engineer from an engineering perspective, when you look again at many of the behaviors and systems that we talk about, there's significant evidence of engineering. And when you do engineering, you definitely have goals and purposes for how you're designing something. Whether it be some physical mechanism or behavior, there's a construct there that the engineer has in mind. Okay, this is the purpose, this is the function that I want to design this thing to do. So that's, again, evidence that there is some higher level purpose involved in how these systems or behaviors are designed.

Robert Marks:

Thanks, Eric. This has been a great and wonderful chat. I've really enjoyed this time with you. Let me summarize the points I think as you have made them. The source of the algorithms in animals requires an explanation. Where does this come from? It can't be from a blind search, is this it? No. Is this it? No. Can't come from that. Where do the information for all of these algorithm come from and why is there convergence? Why do we see similar aspects among different species and among geographically separated species? Why do we see such commonality there, if there is no teleological aspect of their design?

Robert Marks:

These and other things, and fascinating things are addressed in Eric Cassell's new book, Animal Algorithms, published by Discovery Press. I have read it. I endorse it. And it's fun and an informative read. So please get a copy, if this sort of stuff interests you. So until next time be of good cheer.

Announcer:

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