Survival of the fittest theory: Darwinism's limits

03 February 2010 by Jerry Fodor and Massimo Piattelli-Palmarini
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READERS in search of literature about Darwin or Darwinism will have no trouble finding it. Recent milestone anniversaries of Darwin's birth and of the publication of *On the Origin of Species* have prompted a plethora of material, so authors thinking of adding another volume had better have a good excuse for it. We have written another book about Darwinism, and we urge you to take it to heart. Our excuse is in the title: *What Darwin Got Wrong*.

Much of the vast neo-Darwinian literature is distressingly uncritical. The possibility that anything is seriously amiss with Darwin's account of evolution is hardly considered. Such dissent as there is often relies on theistic premises which Darwinists rightly say have no place in the evaluation of scientific theories. So onlookers are left with the impression that there is little or nothing about Darwin's theory to which a scientific naturalist could reasonably object. The methodological scepticism that characterises most areas of scientific discourse seems strikingly absent when Darwinism is the topic.

If Darwin had known what we know now, he might have come to different conclusions (Image: Anna Gowthrope/PA Wire/AP)

> Much of the vast neo-Darwinian literature is distressingly uncritical

Try these descriptions of natural selection, typical of the laudatory epithets which abound in the literature: "The universal acid" (philosopher Daniel Dennett in *Darwin's Dangerous Idea*, 1995); "a mechanism of staggering simplicity and beauty... [it] has been called the greatest idea that anyone ever had... it also happens to be true" (biologist Jerry Coyne in *Why Evolution is True*, 2009); "the only workable theory ever proposed that is capable of explaining life we have" (biologist and ethologist Richard Dawkins, variously). And as Dennett continues in *Darwin's Dangerous Idea*: "In a single stroke, the idea of evolution by natural selection unifies the realm of life, meaning, and purpose with the realm of space and time, cause and effect, mechanism and physical law."

Golly! Could Darwinism really be that good?

Darwin's theory of evolution has two connected parts: connected, but not inseparable. First, there is an explanation of the taxonomy of species. It is an ancient observation that if you sort species by similarities among their phenotypes (a phenotype being a particular creature's collection of overt, heritable biological properties) they form the hierarchy known as a "taxonomic tree".

This is why most vertebrate species are more similar to one another than they are to any invertebrate species, most species of mammals are more similar to

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one another than they are to any species of reptiles, and so forth. Why is this? It is quite conceivable that every species might be equally different from every other. What explains why they aren't?

Darwin suggested a genealogical hypothesis: when species are relatively similar, it's because they are descended from a relatively recent common ancestor. In some ways, chimps seem a lot like people. This is not because God created them to poke fun at us, or vice versa; it is because humans and chimps are descended from the same relatively recent primitive ape.

The current consensus is that Darwin was almost certainly right about this. There are plausible exceptions, notably similarities that arise from evolutionary convergence, but evidence from a number of disciplines, including genetics, evolutionary developmental biology and palaeontology argues decisively for Darwin's historical account of the taxonomy of species. We agree that this really was as brilliant an idea as it is generally said to be.

But that cannot be the whole story, since it is not self-evident why species that have a recent common ancestor - as opposed, say, to species that share an ecology - are generally phenotypically similar. Darwin's theory of natural selection is intended to answer this question. Darwinists often say that natural selection provides the mechanism of evolution by offering an account of the transmission of phenotypic traits from generation to generation which, if correct, explains the connection between phenotypic similarity and common ancestry.

Moreover, it is perfectly general: it applies to any species, independent of what its phenotype may happen to be. And it is remarkably simple. In effect, the mechanism of trait transmission it postulates consists of a random generator of genotypic variants that produce the corresponding random phenotypic variations, and an environmental filter that selects among the latter according to their relative fitness. And that's all. Remarkable if true.

Compelling evidence

But we don't think it is true. A variety of different considerations suggesting that it is not are mounting up. We feel it is high time that Darwinists take this evidence seriously, or offer some reason why it should be discounted. Our book about what Darwin got wrong reviews in detail some of these objections to natural selection and the evidence for them; this article is a brief summary.

Here's how natural selection is supposed to work. Each generation contributes an imperfect copy of its genotype - and thereby of its phenotype - to its successor. Neo-Darwinism suggests that such imperfections arise primarily from mutations in the genomes of members of the species in question.

What matters is that the alterations of phenotypes that the mechanisms of trait transmission produce are random. Suppose, for example, that a characteristic coloration is part of the phenotype of a particular species, and that the modal members of the *i*th generation of that species are reddish brown. Suppose, also, that the mechanisms that copy phenotypes from each generation to the next are "imperfect" in the sense given above. Then, all else being equal, the coloration of the $i + 1$th generation will form a random distribution around the mean coloration of the parent generation: most of the offspring will match their parents more or less, but some will be more red than brown, and some will be more brown than red.

This assumption explains the random variation of phenotypic traits over time, but it doesn't explain why phenotypic traits evolve. So let's further assume that, in the environment that the species inhabits, the members with brownish coloration are more "fit" than the ones with reddish coloration, all else being equal. It doesn't much matter exactly how fitness is defined; for convenience, we'll follow the current consensus according to which an individual's relative fitness co-varies with the probability that it will contribute its phenotypic traits to its offspring.

Given a certain amount of conceptual and mathematical tinkering, it follows that, all else again being equal, the fitness of the species's phenotype will generally increase over time, and that the phenotypes of each generation will resemble the phenotype of its recent ancestors more than they resemble the phenotypes of its remote ancestors.

That, to a first approximation, is the neo-Darwinian account of how phenotypes

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evolve. To be sure, some caveats are required. For example, even orthodox Darwinists have always recognised that there are plenty of cases where fitness doesn't increase over time. So, for example, fitness may decrease when a population becomes unduly numerous (that's density-dependent selection at work), or when a species having once attained a "fitness plateau" then gets stuck there, or, of course, when the species becomes extinct.

Such cases do not show that neo-Darwinism is false; they only show that the "all else being equal" clauses must be taken seriously. Change the climate enough and the next generation of dinosaurs won't be more fit than its parents. Hit enough dinosaurs with meteors, and there won't be a next generation. But that does not argue against Darwinian selection, as this claims only to say what happens when the ecology doesn't change, or only changes very gradually, which manifestly does not apply in the case of the dinosaurs and the meteorite strikes.

So much for the theory, now for the objections. Natural selection is a radically environmentalist theory. There are, therefore, analogies between what Darwin said about the process of evolution of phenotypes and what the psychologist B. F. Skinner said about the learning of what he called "operant behaviour" - the whole network of events and factors involved in the behaviour of humans and non-human animals.

Driven from within

These analogies are telling. Skinner's theory, though once fashionable, is now widely agreed to be unsustainable, largely because Skinner very much overestimated the contribution that the structure of a creature's environment plays in determining what it learns, and correspondingly very much underestimated the contribution of the internal or "endogenous" variables - including, in particular, innate cognitive structure.

In our book, we argue in some detail that much the same is true of Darwin's treatment of evolution: it overestimates the contribution the environment makes in shaping the phenotype of a species and correspondingly underestimates the effects of endogenous variables. For Darwin, the only thing that organisms contribute to determining how next-generation phenotypes differ from parent-generation phenotypes is random variation. All the non-random variables come from the environment.

Suppose, however, that Darwin got this wrong and various internal factors account for the data. If that is so, there is inevitably less for environmental filtering to do.

The consensus view among neo-Darwinians continues to be that evolution is random variation plus structured environmental filtering, but it seems the consensus may be shifting. In our book we review a large and varied selection of non-environmental constraints on trait transmission. They include constraints imposed "from below" by physics and chemistry, that is, from molecular interactions upwards, through genes, chromosomes, cells, tissues and organisms. And constraints imposed "from above" by universal principles of phenotypic form and self-organisation - that is, through the minimum energy expenditure, shortest paths, optimal packing and so on, down to the morphology and structure of organisms.

Over the aeons of evolutionary time, the interaction of these multiple constraints has produced many viable phenotypes, all compatible with survival and reproduction. Crucially, however, the evolutionary process in such cases is not driven by a struggle for survival and/or for reproduction. Pigs don't have wings, but that's not because winged pigs once lost out to wingless ones. And it's not because the pigs that lacked wings were more fertile than the pigs that had them. There never were any winged pigs because there's no place on pigs for the wings to go. This isn't environmental filtering, it's just physiological and developmental mechanics.

So, how many constraints on the evolution of phenotypes are there other than those that environmental filtering imposes? Nobody knows, but the picture now emerging is of many, many of them operating in many, many different ways and at many, many different levels. That's what the evolutionary developmental school of biology and the theory that gene regulatory networks control our underlying development both suggest. And it strikes us as entirely plausible.

It seems to us to be no coincidence that neo-Darwinian rhetoric in the literature of experimental biology has cooled detectably in recent years. In its place, we find evolutionary biologist Leonid Kruglyak being quoted in *Nature* in November 2008 (vol 456, p 18) thus: "It's a possibility that there's something [about the contributions of genomic structure to the evolution of complex phenotypes] we just don't fundamentally understand... That it's so different from what we're thinking about that we're not thinking about it yet."

And then there is this in March 2009 from molecular biologist Eugene Koonin, writing in *Nucleic Acids Research* (vol 37, p 1011): "Evolutionary-genomic studies show that natural selection is only one of the forces that shape genome evolution and is not quantitatively dominant, whereas non-adaptive processes are much more prominent than previously suspected." There's quite a lot of this sort of thing around these days, and we confidently predict a lot more in the near future.

Darwinists say that evolution is explained by the selection of phenotypic traits by environmental filters. But the effects of endogenous structure can wreak havoc with this theory. Consider the following case: traits t_1 and t_2 are endogenously linked in such a way that if a creature has one, it has both. Now the core of natural selection is the claim that phenotypic traits are selected for their adaptivity, that is, for their effect on fitness. But it is perfectly possible that one of two linked traits is adaptive but the other isn't; having one of them affects fitness but having the other one doesn't. So one is selected for and the other "free-rides" on it.

We should stress that every such case (and we argue in our book that free-riding is ubiquitous) is a counter-example to natural selection. Free-riding shows that the general claim that phenotypic traits are selected for their effects on fitness isn't true. The most that natural selection can actually claim is that some phenotypic traits are selected for their effects on fitness; the rest are selected for... well, some other reason entirely, or perhaps for no reason at all.

Every case of free-riding is a counter-example to natural selection

It's a main claim of our book that, when phenotypic traits are endogenously linked, there is no way that selection can distinguish among them: selection for one selects the others, regardless of their effects on fitness. That is a great deal less than the general theory of the mechanics of evolution that the Darwinists suppose that natural selection provides. Worse still, there isn't the slightest reason to suppose that free-riding exhausts the kinds of exceptions to natural selection that endogenous structures can produce.

"All right," you may say, "but why should anybody care?" Nobody sensible doubts that evolution occurs - we certainly don't. Isn't this a parochial issue for professional biologists, with nothing cosmic turning on it? Here's why we think that is not so.

Natural selection has shown insidious imperialistic tendencies. The offering of post-hoc explanations of phenotypic traits by reference to their hypothetical effects on fitness in their hypothetical environments of selection has spread from evolutionary theory to a host of other traditional disciplines: philosophy, psychology, anthropology, sociology, and even to aesthetics and theology. Some people really do seem to think that natural selection is a universal acid, and that nothing can resist its powers of dissolution.

However, the internal evidence to back this imperialistic selectionism strikes us as very thin. Its credibility depends largely on the reflected glamour of natural selection which biology proper is said to legitimise. Accordingly, if natural selection disappears from biology, its offshoots in other fields seem likely to disappear as well. This is an outcome much to be desired since, more often than not, these offshoots have proved to be not just post hoc but ad hoc, crude, reductionist, scientistic rather than scientific, shamelessly self-congratulatory, and so wanting in detail that they are bound to accommodate the data,

however that data may turn out. So it really does matter whether natural selection is true.

That's why we wrote our book.

Profile
Jerry Fodor is a philosopher and cognitive scientist at Rutgers University, New Jersey. Massimo Piattelli-Palmarini is a cognitive scientist at the University of Arizona, Tucson. This essay draws on material from their new book, *What Darwin Got Wrong*, published in the US by Farrar, Straus, and Giroux, and in the UK by Profile

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Thus Speaks Polemosesque

Wed Feb 03 18:27:12 GMT 2010 by **Polemosesque**
http://www.skattybrainology.org

This is what I have been saying for years and confirms my theory. Thus speaks Polemosesque:

All creatures have a biogenetic field which is monotonic co-function of their quantum potential field. Ontological Godellian Virtual Pairs form from the quantum vacuum and entangle non-locally with other virtual pairs in other parts of the Co-universe (the correct name for the Holographic Universe) surjectively. This communicates the intention of the morphic resonance field (George Lucas "The Force") that binds together all living things and via the midi-chlorians forms creatures resembling each other across the universe (bipedal, symmetrical, speaking english). This has nothing to do with natural selection and Darwin was only part right until I came along.

Thus spoke Polemosesque.

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Thus Speaks Polemosesque
Wed Feb 03 18:55:30 GMT 2010 by **Twozero**

I have also heard this is true.

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Thus Speaks Polemosesque
Wed Feb 03 20:14:12 GMT 2010 by **David**

This is introduced as evidance is mounting up against natural selection. This evidance can only mount up to a pile of ..... Because nothing in science is truer that ns outside of mathematics as it is observable left right and centre from breeds of dogs and atificialy evolved fruit flys in the lab to mrsa and a noteble experiment involving a decades isolation of some bacteria. Of these observations and many similar only ns can offer any explanation with no other remote alternatives

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Thus Speaks Polemosesque
Thu Feb 04 00:06:31 GMT 2010 by **ziphead**

sure dude, we getchya... now pass the bong around...

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Thus Speaks Polemosesque
Thu Feb 04 01:26:11 GMT 2010 by **I Doubt That**

Not a bad parody of Polemos/Zephir, except the spelling and grammar are a little too good. (And don't forget the "aether wave" stuff next time).

I think some people here think you're for real. Poe's Law etc.

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Thus Speaks Polemosesque
Thu Feb 04 03:03:56 GMT 2010 by **Liza**

Do you really think Polemos and Zephir are the same? Their styles are pretty different, and the points they argue as well. And Zephir writes an obviously "foreign" English, maybe something east-European, while Polemos seems a native speaker.

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Thus Speaks Polemosesque
Thu Feb 04 10:27:59 GMT 2010 by **I Doubt This**

I Doubt This

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What The Authors Got Wrong
Wed Feb 03 18:41:13 GMT 2010 by **Brian Sims**
http://www.dailykos.com/user/Simian

"It's a main claim of our book that, when phenotypic traits are endogenously linked, there is no way that selection can distinguish among them: selection for one selects the others, regardless of their effects on fitness."

Well, then, a main claim of the authors' book is wrong. Their leap from the (correct) example of how a free-rider linked phenotypic trait that does not affect fitness will be passed on as a result of selection for or against the linked trait, to this more general statement, is not supported by logic or evidence. When phenotypic traits are endogenously linked, natural selection must still play a part. Selection for one trait selects for the linked traits, obviously, but the effect on fitness becomes the sum of the linked traits. The authors' "main claim" is only true when the linked traits do not affect fitness. It follows that his idea is far less revolutionary than he suggests

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What The Authors Got Wrong
Wed Feb 03 23:27:25 GMT 2010 by **Johnathon**

I completely agree. This entire argument is based on misinformation, the claims made by the author's are not scientifically sound or backed by any credible research. It is a shame that the authors have chosen to smear the name of Darwin and all subsequent intelligent like-minded scientists for their fifteen minutes of fame and a paycheck

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What The Authors Got Wrong
Thu Feb 04 00:34:25 GMT 2010 by **rn**

Agreed with these two comments.

I read the article with an open mind and it seems that they have a completely meaningless argument founded on incorrect assumptions.

There's a reason they stick to the complex scientific language. Their argument doesn't require it, but it makes it sound more serious to people who don't know what words like "endogenous" mean.

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What?
Wed Feb 03 18:52:38 GMT 2010 by **Ben**

If trait 1 (t1) is linked to trait 2 (t2) genetically, and t1 is not useful but t2 is, then surely choosing t1 is still classical natural selection?

t1 gets you t2 which makes you more fit.

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What?
Wed Feb 03 19:38:39 GMT 2010 by **chris**

I agree. there's nothing here that is new to any thinking person. It is fairly obvious that some traits are selected by merely being non-harmful, or being linked to a beneficial trait

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What?
Thu Feb 04 02:12:24 GMT 2010 by **Dann**

What is more, subsequent mutation may well unlink the two traits, in which case the 'free-rider' no longer enjoys positive (albeit vicarious) selection and falls by the wayside.

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What?
Thu Feb 04 12:59:44 GMT 2010 by **Liza**

I'm surprised the authors did not even mention spandrels...

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