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Biological Evolution, Cultural Evolution and the Evolution of Language. Review of Daniel Dennett's *From Bacteria to Bach and Back*

Abstract. Daniel Dennett is one of the giants of contemporary philosophy. His new book, *From Bacteria to Bach and Back*, does reiterate the old motifs, such as “strange inversion of reasoning” or “production without comprehension”. But it is first and foremost a new project, whose goal is to calibrate the theory of universal Darwinism to the very recent developments in science, technology and our lifestyles, the most important of which is the coming of Artificial Intelligence. What Dennett does in the new book offers us “thinking tools” (his own phrase) to understand this changing reality by means of basic Darwinian principles.

Keywords: universal Darwinism; AI; cognitive science; Darwinian Spaces; biological evolution; cultural evolution; evolution of language; memetics.

Introduction

Daniel Dennett is the type of writer who does not produce works of minor importance. All his books, starting with the collection of essays *Brainstorms* (1978), grapple with the grandest philosophical problems – mind and free will, morality or the nature and scope of evolutionary processes. However, some of his titles stand out, not only due to the breath-taking range of subjects they cover and the subtlety of exposition these subjects are given, but also due to the impact they have exerted on contemporary

philosophical debate. Certainly, the 1992 *Consciousness Explained* and the 1996 *Darwin's Dangerous Idea* belong to this class. Although I am about to put forward a largely critical review of the 2017 *From Bacteria to Bach and Back*, I believe that it has all the prerequisites to become another landmark set by Dennett on the landscape of contemporary philosophical debate.

Old Motifs, Friends and Enemies

It should come as no surprise to those familiar with Dennett's work that the topics extensively discussed in the new book include "strange inversion of reasoning" (2017, pp. 20–22, 53–58, 68–78, 410–411) or "design without intelligent design" (2017, pp. 50–52, 84–85, 210–211, 256–258, 316–317), by means of which – on Dennett's account – Darwin was able to show how complex systems have emerged through bottom-up processes of selection. However in the present book, this strategy of explaining evolutionary processes highlights the "competence without comprehension" postulate (2017, pp. 80–87, 94–98, 281–287, 336–341, 386–388; see below), which can certainly be found in Dennett's other works¹ but has never received such an emphatic treatment.

Dennett continues with his sympathies and antipathies.² Regarding evolutionary sentiments, as in the other works (e.g. 1996, 2006), he makes a strong plea for Darwinian adaptationism against the teleological mode of explaining reality that in the Occidental thought goes back to Aristotle's famous analysis of causality (discussed in detail in *Metaphysics* (1998) [Dennett, 2017, pp. 33–34]). In doing so, he sides with his long-standing allies – apart from Darwin, his constant point of reference, they include Hume, Dawkins and Turing (see e.g. Dennett, 1987, 1992, 1996).

The camp of his antagonists likewise includes the set of names well-known from his previous works. On the plane of the philosophy of mind, Dennett again makes a case against Descartes (e.g. 1996), but instead of Cartesian dualism (1996, pp. 180–187) his attack now targets the first-person perspective axiom (*res cogitans*) used by Descartes in accounting for mental processes (1641). The Cartesian stance, in line with Dennett's idiom, is illustrated by vivid metaphors – "Cartesian wound" and "Cartesian

¹ See for example "The Cranes of Culture", the 12th chapter of *Darwin's Dangerous Idea* (1995, pp. 335–369).

² See also Steven Rose's review of *From Bacteria to Bach and Back* in *The Guardian* (2017).

gravity” (2017, pp. 15–22, 364–370). This forms the ground for an onslaught on Searle, another of his long-standing enemies, and specifically on Searle’s appeal to intentionality and competence in explaining behaviour (Dennett, 2017, pp. 364–366; see also Searle, 1980 and Dennett, 1987). A charge is also made against Chomsky, but there is now less concern with Chomsky’s idea of competence (e.g. 1996, pp. 190–200) and more with his anti-evolutionary sentiments when it comes to the emergence of language (2017, pp. 276–281). This brings us to the theory of evolution and the Gould and Lewontin duo with their critique of the adaptationist programme, which is described in the present book as “an unfair caricature” of Darwinian adaptationism (2017, p. 30). Dennett does not engage full-scale in batting down their views, as he did in some of the previous works (e.g. 1996, pp. 132–134, 149–154), but concentrates on the unfortunate consequence that Gould and Lewontin’s critique produced (1979) – a loss of certainty in the power of natural selection as the main evolutionary mechanism (2017, pp. 29–32). According to Dennett, the resultant ferment has given power to all sorts of anti-evolutionary ideas, some of which have been articulated by intellectual giants, such as Chomsky, others by thinkers of lesser note, such as intelligent design propagandists (2017, pp. 309–310).

Of Computers, AI, Minds and Brains

A lot of space in *From Bacteria to Bach and Back* is given to discussing Artificial Intelligence (see e.g. the last chapter “The Age of Post Intelligent Design” [2017, pp. 371–413]). Of course, AI is the subject that Dennett has been exploring for a long time. For example, in *Brainstorms* (1978), he extensively wrote about GOFAI,³ which he used to illustrate the distributed nature of the mind (see Russell & Norvig, 2016) and the “competence without comprehension” postulate (whereby a variety of tasks, including the management of semantic information, is accomplished by digitally operated computers). Dennett is still emphatic about these points (e.g. pp. 150–154, 315–316), and – as already noted – even more emphatic than he used to be about the “competence without comprehension” postulate:

³ Good Old-Fashioned Artificial Intelligence based on Turing’s insight that AI can be built from simple parts (e.g. first-order logic predicates) that are hierarchically organised (Haugeland, 1985).

Comprehension, far from being a Godlike talent from which all design must flow, is an emergent effect of systems of uncomprehending competence: natural selection on the one hand, and mindless computation on the other. These twin ideas have been proven beyond a reasonable doubt, but they still provoke dismay and disbelief in some quarters ... (2017, p. 75)

Such a stance is anything but surprising. For Dennett, as for the majority of cognitive scientists, AI or, more broadly the computer, continues to be the standard point of reference for discussing the nature of mental processes (e.g. Neisser, 1967; Haugeland, 1985). But in *From Bacteria to Bach and Back*, Dennett spends as much time exploring the similarity between the computer and the mind as he does demonstrating the difference between the two. With regard to the former point, he gives much more credit to Alan Turing than he previously did. As noted above, Turing has been one of the landmarks of Dennett's work, but here he elevates Turing to the position up till now occupied by Darwin only. In *From Bacteria to Bach and Back*, Darwin's strange inversion of reasoning is followed by the second strange inversion of reasoning, whose authorship Dennett attributes to Turing (2017, pp. 53–60). Darwin inverted the way we think about the origin of life, replacing the traditional “trickle-down theory of creation” (2017, p. 53; see also Dennett 1996, pp. 64–68) with the evolutionary “bubble-up theory of creation” (2017, p. 54). Turing's contribution to the advancement of our understanding of the world relates to the “competence without comprehension” postulate: the absolute ignorance of computer code instruction, expressed by if-then set of rules, can scale up to intelligent decision-making without any comprehension of how decisions are made:

Turing showed that it was possible to design mindless machines that were Absolutely Ignorant, but that could do arithmetic perfectly, following “instructions” that could be mechanically implemented. More importantly, he showed that if their instructions included *conditional branching* (if-then instructions, such as “if you observe 0, replace it with 1 and move left, and if you observe 1 leave it as is and move right, and change to state *n*.”), then these machines could pursue indefinitely complex paths determined by the instruction, which gave them a remarkable competence: they could do *anything* computational. In other words, a programmable digital computer is a Universal Turing Machine, capable of mimicking any special-purpose digital computer by following a set of instructions that implement that special-purpose computer in software. ... A huge

Design Space of information-processing was made accessible by Turing, and he foresaw that these was a traversable path from Absolute Ignorance to Artificial Intelligence [...] (2017, pp. 55–56)

For Dennett, Turing's mode of thinking incarnated in the digital computer has large-scale consequences. It affords insight into the way our mind works: all that really is to the mind happens at the sub-personal level of neural activity (2017, pp. 348–354), or “the nanomachinery of life” (2017, p. 55), which operates similarly to the digital computer's instructions written in the binary code (2017, pp. 106–109) – neurons either fire or not, and their state of activation leads the activation of other neurons: this is all there is. The subjective experience is linked by Dennett to the “user-illusion of click-and-drag icons [...] and the rest of the ever more familiar items on your computer's desktop” (2017, p. 202). Just as we are not aware of the workings of the software and hardware responsible for the interface we see on the desktop, we are not aware of the neural activity that gives rise to our subjective experience, intentionality and volition. Both the desktop, the computer's interface with reality, and the mind, the brain's interface with reality, are reduced to simple, mechanical processes at the level of circuitry.

The emphasis Dennett puts on Turing's work is not merely a change in rhetoric but indicates a more thoroughgoing change of perspective. Dennett has long been known as the opponent of all types of phenomenology, which assert the irreducibility of (at least some aspect of) the subjective experience. Such a broadly defined phenomenological stance is often accompanied by the methodological postulate that philosophy (all philosophy as in the case of Descartes (1641), or some part of philosophy as in the case Searle's philosophy of language [1980, 1992]) should be based on this irreducible, experiential property (see above “Cartesian gravity”). In *From Bacteria to Bach and Back*, Dennett continues to stick to the lines of critique of the phenomenological stance from the perspective of physicalism (2017, pp. 36–38; see also Dennett, 1987). On the one hand, he stresses that everything that is important in and about the mind happens below the level of consciousness – in the unknowing darkness of neural activity (Dennett, 2017, pp. 160–175). On the other hand, it is still possible to detect his functionalist sentiments when he writes about mental objects (2017, pp. 272–274), word tokens (2017, pp. 183–186) or indeed about consciousness as the user's illusion produced by the brain's operations (2017, pp. 346–347). However, Dennett now insists that the mind is nothing more than a Turing machine – certainly, the mind is differently organised than the digital computer, but the core

structure is the same. This move puts Dennett away from functionalism, with which he has been associated for a long time (in fact, since *Brainstorms*, but see Dennett, 2017, pp. 161–162) and closer to eliminativism, the position which he has never expressly embraced but with which he certainly flirted before (see e.g. Dennett, 1988).

Paradoxically, another characteristic that distinguishes *From Bacteria to Bach and Back* from his previous works is the forcefulness with which Dennett highlights the dissimilarity between the digital computer and the brain. He lists the differences between the two that are often discussed in the literature, but are, in his view, unimportant:

- “brains are analog; computers are digital”; here, he argues that if the understanding of the digital computer is extended beyond the binary mode of operation, then the brain turns out a sort of digital machine, comprising finite neural states equivalent to brain functions (2017, pp. 154–155);
- “brains are parallel ...; computers are serial”, at which juncture he draws attention to the fact that serial machines, based on von Neumann’s old scheme (von Neumann & Morgenstern, 1953), operate so swiftly that they can mimic the parallel architecture of the brain’s operations (2017, p. 155); and
- “brains are carbon based ...; computers are silicon” – Dennett thinks that there is no reason to believe that “the difference in underlying chemistry gives an edge to carbon” (2017, p. 156)

Instead, he focuses on a seemingly banal dissimilarity between brains and computers; namely, that the former are alive, and the latter are not. When accounting for the quality of being alive, he appeals to Deacon’s voluminous book *Incomplete Nature* (2011), and underlines that, unlike computers, brains have to fight for energy, and neurons that fail to receive it die. To put it in Deacon’s terms, brains, like other body organs or whole organisms, are in constant struggle against entropy – loss in this fight means disintegration and death. This feature of brains brings out stark contrast between them and computers, which have a guaranteed supply of energy, and in both Deacon’s and Dennett’s opinion, the “alive” property has fundamental consequences for the functional structure of the brain that emerges bottom-up from life-seeking actions of individual neurons. It seems then that Dennett’s agenda is to show the similarities and differences in the way Darwinian processes operate on entities that are – in the sense described above – alive and that are not alive. And however much time Dennett may spend discussing programming languages, Bayesian networks or deep-learning machines, his focus is all the time on

Darwinian processes. Certainly, the importance of AI topics in the present book is also dictated by the contemporary socio-technological context, when AI has become an integral component of our life. No wonder that Dennett, a universal Darwinist (or rather, the universal Darwinist), tries to present a Darwinian account of this realm.

How Deep Does the Rabbit Hole Go?

From Bacteria to Bach and Back is not, then, a book about Artificial Intelligence; it is a book about evolution. This is surely a blunt statement, but captures the nature of Dennett's undertaking. And there is a strong similarity between his undertaking and the one that Deacon sets upon in *Incomplete Nature*. This work is mentioned so many times that in fact we should describe its author, together with Hume, Darwin and Turing, as one of Dennett's allies (see above). Dennett and Deacon share a bottom-line conviction that Darwinian predictions apply to all types of phenomena. Dennett is not prepared to spend as much time as Deacon explaining how laws of physics, with the second law of thermodynamics at the forefront (2011), account for the appearance, persistence and change of both biological and non-biological structures. The key area that draws his attention to the thermodynamic processes is the emergence of life, i.e. the emergence of reproducing and self-maintaining systems from the prebiotic world. In doing, he uses the familiar Darwinian reversed reasoning:

Start with the minimal specification for a living, reproducing thing – a list of all the things it has to be able to do – and work backward, making an inventory of the available raw materials ..., and asking what sequence of possible events could gradually bring together, non-miraculously, all the necessary parts in the right positions to accomplish the job. (2017, pp. 26–27)

More specifically, Dennett traces the beginnings of life to differential persistence of some abiotic forms, which later gave rise to replication: “Before we can have competent reproducers, we have to have competent persisters, structures with enough stability to hang around long enough to pick up revisions” (2017, p. 48). Later, such forms developed means of reproduction, and gradually all the major characteristics of living organisms, including self-maintenance, energy acquisition and self-repair (2017, pp. 6–8). The ensuing expansion of life forms occurred through essentially the same logistics:

opposing the second law of thermodynamics by means of differential persistence, now expressed by differential reproduction. The R&D of life is the metaphor Dennett uses throughout the book to illustrate how mutation and adaptive change produce systems capable of discovering affordances in the environment and putting them to use, which gives such systems an edge in the reproductive struggle (2017, pp. 54–55). Dennett explains how this R&D machinery, which itself is deprived of any sense of purpose, led to the key breakthroughs in the history of life – the emergence of multicellular organisms, by making the best of the collision between bacteria and archaea, which initiated the “Eukaryotic Revolution” (2017, pp. 7–8); the beginnings of the nervous system; and eventually the appearance of the human brain, which, endowed with intelligence, is capable of producing other intelligent systems:

[T]he Absolute Ignorance of evolution by natural selection is indeed capable of creating not just daisies and fish but also human beings who in turn have the competence to build cities and theories and poems and airplanes, and computers, which in turn could in principle achieve Artificial Intelligence with even higher levels of creative skills than their human creators. (2017, p. 152)

Dennett has always been a keen advocate of universal Darwinism (most importantly, 1996), but in *From Bacteria to Bach and Back* we probably find its strongest enunciation, where Darwinian predictions are applied to abiotic matter or computer programmes. At the same time, here, the bid to subject all explanations to Darwinian principles seems much more convincing than in his previous works, where sometimes Dennett gets carried away by a zest for reductionism, as in the famous passage from *Darwin’s Dangerous Idea*, where he likens Darwinism to acid that dissolves unfounded speculation about the reality:

There is no denying, at this point, that Darwin’s idea is a universal solvent, capable of cutting right to the heart of everything in sight. The question is: what does it leave behind? I have tried to show that once it passes through everything, we are left with stronger, sounder versions of our most important ideas. Some of the traditional details perish, and some of these are losses to be regretted, but good riddance to the rest of them. What remains is more than enough to build on. (1996, p. 21)

The book’s novelty in the way Dennett explains universal Darwinism consists in calibrating the way Darwinian principles apply, depending on the type of phenomena that are under consideration. Key to this enterprise is the concept of Darwinian Spaces, which Dennett has borrowed from Peter Godfrey-Smith (2007) and used as “a new tool for thinking about evolution” (2017, p. 137). And, as can be argued, it is the application of Darwinian Spaces that makes Dennett’s version of universal Darwinism more encompassing than what we find in his previous works, and certainly much more philosophically mature and scientifically realistic than what Deacon does in *Incomplete Nature*.

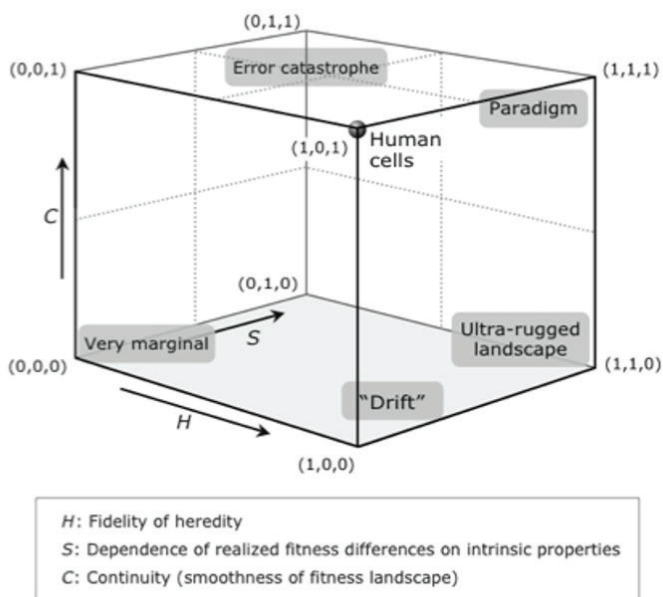


Figure 1. The Godfrey-Smith/Dennett model of Darwinian Spaces (2017, p. 141). The *C* dimension indicates configuration of fitness landscape; the *S* dimension, dependence of evolutionary success on intrinsic properties; the *H* dimension, reproductive fidelity.

The model of Darwinian Spaces is based on the conviction that evolutionary processes can be more or less Darwinian, the fact which according to Dennett captures the essence of Darwinian gradualism (2017, pp. 138–142). In the above visualisation of the model, the *C* dimension indicates the configuration of fitness landscape. On a smooth landscape, i.e. such that is stable (value 1), natural selection is able to operate by taking

small steps until it reaches an optimal fitness. But on a rugged landscape, i.e. when the changeability of conditions frequently changes fitness optima (value 0), it is impossible for natural selection to operate (2017, pp. 141–142). The *S* dimension illustrates the dependence of evolutionary success on intrinsic properties (value 1), e.g. inborn strength or resistance to parasites, rather than on luck or chance (value 0), as in the case of genetic drift (2017, p. 142). Finally, the *H* dimension concerns the fidelity of heredity. When fidelity is low, adaptive changes are impossible because if useful mutations arise, they are destined to be lost (value 0); in the extreme case, a fatal mutation (or an error catastrophe) may arise that will drive a whole population to extinction. Interestingly, maximal high copying fidelity (value 1) also stalls evolution because then there are no mutations, on which selective processes could operate. That is why for Darwinian selection to take place the position on the *H* dimension must be high but should not reach the end of the scale (2017, pp. 140–142).

Dennett shows that the model of Darwinian Spaces can be used to describe both biological and non-biological phenomena. For example, single-celled eukaryotes from which multicellular organisms emerged should be situated in the right upper corner of the space, as a paradigmatic example of Darwinian processes. But cells in our body, which have descended from these organisms, show slightly different characteristics. They score high on the *fidelity* dimension and the *fitness landscape* dimension; however, their “survival” does not so much depend on their intrinsic properties as on chance. For example, neurons that are unlucky not to have made connections with other neurons are going to be pruned, irrespective of their intrinsic biological quality (2017, pp. 142–143). In this sense, the condition of multicellularity is a de-Darwinising context, at least when cells in our bodies are compared to single-celled organisms. Next, Dennett applies Darwinian Spaces to talk about the origin of life (2017, pp. 145–146). Here, the abiotic world occupies the bottom left corner of the space, bacteria occupy the upper right corner, while different processes whereby abiotic entities evolved into bacteria (such as replication, energy capture, growth in complexity) are represented by the vectors leading from the former to the latter. Dennett also argues that the model can be used to compare genetic and cultural evolution, or indeed cultural-evolutionary processes (2017, pp. 146–149). For instance, the copying fidelity of religious rituals is usually so high that it does not allow for variants to emerge, which could promote selective changes. On the other hand, the copying fidelity of words is high but not maximally high, whereby lexical variants appear that enter in competition with one another and in this way lead to a linguistic change.

Thanks to its simplicity and versatility of applications, the model of Darwinian Spaces – “a new tool for thinking about evolution” as Dennett calls it – is likely to make a lasting imprint on the way we conceptualise evolutionary processes. On a critical note, the obvious limitation of the Darwinian Spaces model is that it uses the three-dimensional space, defined by the vectors of *fitness landscape*, *dependence on intrinsic properties* and *reproductive fidelity*. It would not be difficult to find other dimensions important to characterising Darwinian processes, such as for example the *tempo of evolutionary change*, which would help differentiate between typical gradualistic scenarios from punctuated equilibria, or *dependence on one’s own properties*, which could factor in the phenomena of kin selection and horizontal transfer. The three-dimensionality makes Darwinian Spaces more of a visualisation technique, than a model in the strict sense. The building of a multi-dimensional model of Darwin Spaces could be accomplished with machine learning, but – it should be stressed – this version would certainly lack the intuitive appeal of the three-dimensional version described by Godfrey-Smith and Dennett.

Memes and Culture

Dennett has been a long-standing supporter of memetics, ever since Dawkins’s idea came under a heavy siege, following its introduction in *The Selfish Gene* (1976; see also Dawkins, 1982; Blackmore, 1999; Dennett, 1996). The arguments against memes and memetics are well-known and concern the problems of:

- definability of memes as units of cultural selection (e.g. Sperber, 2000; Gill, 2011);
- apparent lack of script for memes, when compared to genes and their DNA script, which casts shadow on how memes, even if successfully defined as discrete units, could be the basis for high-fidelity transmission required for cultural-adaptive processes to take place (most importantly, Benitez-Bribiesca, 2001);
- terminological confusion, whereby memes are portrayed as a pseudoscientific replacement of units of analysis in semiotics and the philosophy of mind, such as “concept” or “sign” (e.g. Deacon, 2004).

The defence strategies used by supporters of memes and memetics are also well-known. As Susan Blackmore has pointed out with regard to the problem of discreteness, genes are not completely discrete but they are

“discrete enough” to underline the manifestation of specific phenotypic effects. Similarly, as this argument runs, memes are “discrete enough” to be causally linked to cultural phenomena (Blackmore, 1999). The “good-enough” approach is also used to respond to the second challenge. In fact, it is Dennett in *Darwin’s Dangerous Idea* (1996), who suggested that memes are first and foremost informational entities and as such they are, in the likeness of genes, sets of instructions for doing specific things (2017, pp. 213–220). However, the idea of meme and memetics does remain controversial, the best example of which is its marked absence in modern research on cultural evolution. Research on cultural evolution is certainly one of the most vibrant fields of contemporary evolutionary science, as evidenced by the foundation of new academic centres dedicated to this area, e.g. Jena’s Max Planck Institute for the Science of Human History (<https://www.shh.mpg.de/en>), or scientific organisations and conference series, such as Cultural Evolution Society and its annual conferences (<https://culturalevolutionsociety.org>). The founders of this field, Cavalli-Sforza and Feldman (1981) or Boyd and Richerson (1985, 2005), did not believe that the concept of meme could give a sound basis for the science of cultural evolution. Since then, the science of cultural evolution has shed much light on processes of cultural transmission and innovation, exploring such issues as learnability and cognitive bias (e.g. Kirby et al., 2008; Winters et al., 2015; Kirby, 2017), modality of transmission (e.g. Fay et al., 2013; Fay et al., 2014) or characteristics of populations (e.g. Henrich, 2004; Lupyan & Dale, 2010). And all this progress has been made without making any appeal to memes.

Perhaps, the science of cultural evolution is in the position similar to that of early Darwinism, which began to flourish without an adequate theory of inheritance. But it is very unlikely that after reading *From Bacteria to Bach and Back*, the practitioners of this science will be persuaded to embrace memetics as an adequate theory of cultural inheritance. Dennett devotes a lot of time to defending memetics and describing cultural evolution from a meme’s eye point of view (the whole chapter 10 is devoted to this problem), but in doing so, he tends to repeat or, at best, augment the old arguments. First of all, a memetic perspective on culture agrees with the postulate of “competence without comprehension”. As argued by Dennett, memetics is able to show that products of culture – melodies, architectural styles, achievements of craftsmanship, etc., which all seem *par excellence* examples of Intelligent Design – are in fact products of differential replication of ideas transmitted by unsuspecting carriers of these ideas: “Human comprehension – and approval is neither necessary nor sufficient for the fixation of a meme

in a culture” (2017, p. 211). Then, following early Dawkins’s formulation (1976), Dennett insists that memes are selfish, i.e. their goal is their own reproductive success, which is independent of the reproductive success of their carriers. This is because the life of memes is much too short to have any significant impact on their human hosts; hence, argues Dennett, fitness of memes must be independent of their carriers’ fitness. Finally and most importantly in the context of the present book, Dennett emphasises his argument about the informational nature of memes (see above):

Memes are informational things. They are “prescriptions” for ways of doing things that can be transmitted, stored, and mutated without being executed or expressed (rather like recessive genes traveling silently in a genome). Marco Polo is thought to have brought the pasta meme to Europe from China; he didn’t have to become a pasta chef to do this; all he had to do was disperse copies of the meme in environments where other human beings could become infected by it, and express it in their ways of behaving. (2017, p. 211)

It is easy to see that memes, at least as described above (for other approaches see e.g. Cullen, 2000; Aunger, 2002; Ritt, 2004), fit very well the type of universal Darwinism advocated in *From Bacteria to Bach and Back*, which reduces reality to Darwinian processes and further seeks to reduce Darwinian processes to evolutionary algorithms (see above: the second strange inversion of reasoning). However, as already noted, such a presentation of memes is not novel, and it is doubtful whether it is capable of exerting a formative influence on the science of cultural evolution. Dennett does refer to new research on cultural evolution and does so extensively (the references include over 30 works on cultural evolution published after 2000). Even though this research has fared very well without delimiting the basic unit of cultural evolution, for Dennett the problem of defining such a unit (of course along memetic lines) remains the fundamental question for cultural evolution. In this respect, his view does not seem to have changed since the publication of *Darwin’s Dangerous Idea*.

Many proponents of memetics, Dennett included, draw attention to the (alleged) similarity in the way viruses and memes operate (Williams, 1992; Dawkins, 2004; Dennett, 1996). The standard presentation of this analogy is repeated in Dennett’s new book. Memes, like viruses, require a host to reproduce, which in the case of memes is not the host’s cell, but the (human) host’s brain: just as the virus uses the cell’s RNA to reproduce, the meme uses our brain’s “instinct to imitate or copy” (2017, p. 284). Although

Dennett stresses the symbiotic nature of the meme-host interaction, and even acknowledges that the copying of memes might have provided some (genetic) fitness to our ancestors (2017, p. 284), his perspective – just like that of Dawkins and Williams (see above) – asserts that meme replication primarily concerns the meme’s fitness. In keeping with the virus-meme analogy, Dennett argues that the symbiotic nature of memes serves to ensure their reproduction, memes do not kill the host, provided it is the type of host that facilitates their reproduction:

Like viruses and other symbionts by the trillions that have taken up residence in our bodies, the invaders evolved to be more effective reproducers, holding their own against the competition within bodies and winning the dispersal competitions, spreading to new hosts. They must have included enough mutualists and commensals among the parasites not to kill off their hosts, though it is entirely possible that waves of meme infection did just that before one wave finally happened to be benign enough to secure a long-term foothold. (2017, p. 285)

Such a meme-centric view of culture is at loggerheads with the mainstream of research on cultural evolution, which concentrates on the fitness bestowed by elements of culture onto their users, not onto elements of culture themselves – to mention for example the research on the dual-inheritance hypothesis (e.g. Boyd & Richerson, 2006; Gintis, 2009), social learning (e.g. Whiten, 2017; Laland, 2018) or niche construction (e.g. Odling-Smee et al., 2003; Mathews et al., 2014, Laland et al., 2016), all which Dennett mentions in his book but somehow fails to see the incompatibility of his ideas with these approaches. Even more surprisingly, he does not refer to these ideas in cultural evolution that also highlight memetic perspective. For example, Dennett does not address the conceptualisation of elements of language as the “useful parasite” (Christiansen, 1994; Christiansen & Charter, 2009). The “useful parasite” analogy⁴ serves to indicate, in a much more emphatic way than Dennett is prepared to do, that to effectively increase their fitness, cultural reproducers must increase their host’s fitness. But there is yet another insight afforded by the analogy: given the timescales of biological and cultural evolution, these are cultural entities that in the first place must adapt to the environment of the human brain, than the other way round.

⁴ It seem that the more appropriate term would be “the useful mutualist”, as explained by Dennett himself (2017, p. 193).

The bulk of research on cultural evolution concentrates on this problem. For the example, research conducted in the iterated learning paradigm (e.g. Kirby et al., 2008; Kirby, 2017) that has demonstrated how cognitive biases, e.g. related to learnability, exert a formative influence on culturally transmitted entities. Although Dennett refers to the foundational text on the “useful parasite” analogy – Christiansen and Charter’s BBS article “Language as Shaped by the Brain” (2008) – and to works from the iterated learning tradition (Claidière et al., 2014), he turns a blind eye to what these sources tell us about the nature of cultural-evolutionary processes.

From Words to Language

The memetic concerns bring us to language and its evolution. Here, Dennett’s unwillingness to take in new insights is even more glaring than in the case of cultural evolution. Language evolution is discussed in *From Bacteria to Bach and Back*, and is discussed more extensively than in his previous works, where Dennett’s remarks on the subject were limited to comments occasioned by some other topics (e.g. memetic processes as in the 14th chapter of *Darwin’s Dangerous Idea* [1995, pp. 401–427]). In the present book, he emphatically notes that the problem of language origin is like the problem of life origin because both were most probably unique events in the history of our planet (2017, p. 249). But Dennett does not seem to be interested in the problem of language evolution as such, but uses it primarily to solidify his meme-centric perspective on cultural evolution.

Since Dawkins proposed the idea of “meme”, words – most commonly understood as lexical labels (Waciewicz, 2015) – have been used to illustrate this idea (Dawkins, 1982; Wilkins, 1998; Blackmore, 1999). Dennett’s work is no exception in this respect (e.g. 1996), and *From Bacteria to Bach and Back* is replete with such illustrations, with one subsection “Words as Memes” (in the 10th chapter, 2017, pp. 205–208) specifically devoted to elaborating the memetic status of words. His explanation of this problem is rather trite: words, though they are not material, are real in this sense of being bits of information – “informational structures ... that determine ways of doing things” (2017, pp. 224–225); just like viruses (memeticians’ standard analogy; see above), words *qua* memes need hosts to replicate and these hosts are learners’ brains (2017, pp. 176–177).

However, Dennett pushes the biologism of the description of words further, and claims that words are not only “discrete, faithfully transmitted

gene-like entities”⁵ (2017, p. 225) but they have the dual nature, similar to that of biological entities. Words’ informational structure is equivalent to biological entities’ genetic structure and forms that words assume in individual brains are equivalent to phenotypic manifestations of the genetic structure (2017, pp. 224–247; see also McCrohon, 2012). Words reproduce differentially (2017, p. 412), with some variants arising as copying errors (e.g. 2017, p. 182), as in the case of alleles, and the competition between lexical variants is responsible for the reproductive success of some of them and the reproductive breakdown of others.

All these arguments are not novel and can be found in other works on memetics (see e.g. Blackmore on *tremes* [2010]) including Dennett’s own texts (most importantly, Dennett, 1996). There are new insights, such as the idea that word etymologies could be studied in the way lineages of individual genes are studied in biological evolution (2017, pp. 180–182). Dennett’s account also contains an interesting discussion about Lamarckian elements in cultural evolution, with words used as the main example, which builds up to a defence of Darwinian selection as the primary mechanism responsible for cultural-evolutionary processes (2017, pp. 243–246). Finally, unlike in his other works, Dennett makes an attempt to set his discussion of words in a larger, semiotic context, referring to Pierce’s token/type distinction (2017, pp. 182–187; Pierce, 1906), although reference to Pike’s “emic/etic” dichotomy would also be in order (Pike, 1967).

What is symptomatic of Dennett’s meme-centric perspective is how he uses the problem of words to reflect on the nature of language as a system, often going abruptly from the description of the former to the latter. For example, when describing words as “the lifeblood of cultural evolution” (2017, p. 179) and the evolutionary processes they are subjected to, he writes: “The idea that languages evolve, that words today are the descendants in some fashion of words in the past, is actually older than Darwin’s theory of evolution of species” (2017, p. 182). Even if Dennett thinks that the lexical system is the most important element of language, as he admits (see e.g. 2017, pp. 248–250; also 1996, pp. 378–382), he should show a greater sensitivity to the complex nature of language. There is a growing consensus in research on language that different elements of language, to use Botha’s famous phrase “the assorted beasts called language” (2000), could have had different, though intertwining, evolutionary histories (Fitch, 2010; cf. Wacewicz & Żywiczyński 2015; Wacewicz et al. 2017)).

⁵ This is in fact Boyd and Richerson’s phrase used by Dennett to illustrate their criticism of memetics (2005, p. 63).

As noted above, Dennett introduces the problem of language evolution by comparing it to the problem of the origin of life, and describes it using Christiansen and Kirby's dictum, as the "hardest problem in science" (2003), but from what he writes, particularly in the 12th chapter "The Origins of Language" (2017, pp. 248–281), we can conclude that the evolutionary emergence of language is a relatively simple story. Following Bickerton (2009, 2014) and Jackendoff (2002), his primary sources of insight into language evolution, Dennett claims the first step in this process was the emergence of lexical labels that stood for concepts. In doing so, he does not seem to have a clear idea why lexical labels developed. Dennett argues, for example, that words are synanthropic – i.e. that by close association with humans they self-domesticated themselves, similarly to how the ancestors of dogs domesticated themselves (rather than were domesticated by humans; see Coppinger & Coppinger, 2001) by staying close to human settlements (2017, pp. 197–198). Such statements may be attractive on rhetorical grounds, but they hardly lead to specifying a definite selection pressure that is responsible for the development of words. Dennett may not have a clear idea why words emerged, but seems much more certain about the manner in which this happened.

Referring to the concept of self-organisation described by Hurford in *The Origins of Language: A Slim Guide* (2014) as well as the iterated learning experiments (Claidière et al., 2014), he uses the meme-centric perspective to account for the emergence of words:

It was "in the interest" of audible memes, meaningful or not, to distinguish themselves from the competition but also to exploit whatever habits of tongue prevailed locally – when in Rome sound like the Romans sound or risk extinction – whereas it was "in the interest" of host/speaker/hearers to minimize the load on memory and articulation by keeping the repertoire of distinct sound-types fairly compact and efficient. No "conscious effort" is required because the immediate pressures are the selective pressures of differential replication. (2017, pp. 268–269)

In this way, phonology and semantics were born. The further development of language – here again the main reference is Hurford's *Slim Guide* – was the effect of the process of grammaticalisation,⁶ which pushed lexical protolanguage towards fully fledged language (2017, p. 270). The

⁶ Dennett makes no reference to Heine and Kuteva, who extended the grammaticalization theory onto language evolution (Heine & Kuteva, 2007).

first phase of this process consisted in the acquisition of a topic/comment distinction (2017, p. 270). The development of regular syntactic rules was the impact of larger and larger populations using languages (2017, pp. 271–272), which led to the emergence of the complex syntax characteristic of modern languages; yet again, Dennett relies on Hurford's work, without citing the original sources, where this line of argumentation was developed (such as Wray & Grace, 2007 or Lupyán & Dale, 2010).

Dennett's story how language evolved certainly serves his needs very well – it is designed to show that language emerged bottom-up, with the decisive role played by selection processes operating at the memetic level. And it must be admitted that it is a scenario that many important researchers in language evolution could agree with (e.g. Bickerton, 1990, 2009; Jackendoff, 2002; Pinker, 2003). But his story is also a very patchy one, and given the recent progress made by the science of language evolution (see e.g. Fitch, 2017), it is also grossly underinformed. For example, it is a pity that Dennett uses as one of the main sources Hurford's *Slim Guide*, which is an excellent read but one that is designed as a popular introduction to the field of language evolution, but ignores Hurford's 2 voluminous books *The Origins of Meaning* (2007) and *The Origins of Grammar* (2011). The crux of Dennett's idea about language evolution is the development of vocal lexical protolanguage, which later acquired syntax – this is a scenario drawn by Bickerton (1990, 2009) and Jackendoff (2009), whom he quotes many times (2017, pp. 188, 262–264, 268, 273–279, 282, 303, 353). But this allegiance does not refrain him from considering the conceptions incompatible with the vocal lexical protolanguage view, such as the holistic protolanguage view (Wray, 1998; Mithen, 2005; Arbib, 2012), which holds that lexicon emerged through segmentation of utterance-like units, or the gestural view, which holds that protolanguage was used in the motoric-visual channel and not the vocal-auditory one (Corballis, 2003; Armstrong & Wilcox, 2007; Zlatev et al., 2017). Another weakness is that Dennett is not prepared to confront his scenario with other accounts important in contemporary language evolution, such as the syntax-first scenario proposed by Fitch (2010). It is a pity that, despite the declarations about the importance of the topic, Dennett treated language evolution instrumentally – to serve his theoretical agenda, and showed no interest to engage in a thorough discussion of the problem.

Conclusion

From Bacteria to Bach and Back may have weaker moments, of out which the discussion of language evolution is probably the weakest. Dennett's explanations may occasionally seem out of touch with the most recent research, as is the case with his account of cultural evolution. The book may seem reiterative, at least with regard to some topics, such as "strange inversion of reasoning" or memes. But these shortcomings do not compromise Dennett's major philosophical achievement. On the pages *From Bacteria to Bach and Back*, he successfully calibrates his message of universal Darwinism in view of new developments in science, technology and our lifestyles, the most important of which seems to be the coming of Artificial Intelligence. What Dennett does in the new book offers us "thinking tools" (his own phrase) to understand this changing reality by means of basic Darwinian principles. As such, *From Bacteria to Bach and Back* should become an obligatory reading for evolutionary researchers, philosophers and in fact for all readers who want to go beyond how things appear and understand how they really are.

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