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## Is the creation of artificial life morally significant?

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### ABSTRACT

In 2010, the Venter lab announced that it had created the first bacterium with an entirely synthetic genome. This was reported to be the first instance of 'artificial life,' and in the ethical and policy discussions that followed it was widely assumed that the creation of artificial life is in itself morally significant. We cast doubt on this assumption. First we offer an account of the creation of artificial life that distinguishes this from the derivation of organisms from existing life and clarify what we mean in asking whether the creation of artificial life has moral significance. We then articulate and evaluate three attempts to establish that the creation of artificial life is morally significant. These appeal to (1) the claim that the creation of artificial life involves playing God, as expressed in three distinct formulations; (2) the claim that the creation of artificial life will encourage reductionist attitudes toward the living world that undermine the special moral value accorded to life; and (3) the worry that artificial organisms will have an uncertain functional status and consequently an uncertain moral status. We argue that all three attempts to ground the moral significance of the creation of artificial life fail, because none of them establishes that the creation of artificial life is morally problematic in a way that the derivation of organisms from existing life forms is not. We conclude that the decisive moral consideration is not how life is created but what non-genealogical properties it possesses.

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In 2010, staff at the J. Craig Venter Institute (JCVI) reported the creation of the first bacterium with an entirely synthetic genome. A variant on the *Mycoplasma mycoides* genome was stitched together from simple chemical building blocks and then inserted into a bacterium from a different *Mycoplasma* species whose genetic contents had been removed. The result was a novel bacterium that was capable of reproducing and performing other normal bacterial functions (Gibson et al., 2010).

The JCVI's creation was widely reported as the first example of artificial life. It is doubtful whether it was aptly characterised as such, given that only the genome and none of the cytoplasmic structures were synthesised by scientists (Bedau et al., 2010). However, in this paper we take no committed stance on whether the JCVI's bacterium constituted artificial life. Instead, we consider whether it would have mattered, morally, if it did. Even if JCVI scientists did *not* create artificial life, this is an important question to ask since future scientists may well do so.

In the controversy that surrounded the JCVI's creation, which prompted a meeting of the U.S. Presidential Commission for the Study of Bioethical Issues and an ensuing ethical report (2010), it was widely assumed that the creation of artificial life *is itself* morally significant. In this article we aim to cast doubt on this assumption. First we offer an account of what it is to create artificial life and clarify what we mean in asking whether the creation of artificial life has moral significance. We then articulate and evaluate three attempts to establish that the creation of artificial life is morally significant: one based on the concern that the creation of artificial life involves playing God, one claiming that it will encourage reductionist attitudes toward life, and one which argues that artificial organisms will have uncertain moral status. We show that all three attempts fail.

### 1. Definitions

We shall first lay out some key definitions.

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### 1.1. Creating artificial life

The creation of artificial life would have to consist, we assume, in the creation of an artificial *living entity*, henceforth an ‘artificial organism’.<sup>1</sup> We will take an organism to be artificial just in case *either* (1) all core elements of that organism were initially constructed from chemically simple, non-living components to the specification of a person or other natural rational being,<sup>2</sup> or (2) it descended from an organism (or pair of organisms in the case of sexual creatures) that was constructed in this way.

There are several points to note about this definition. First, it does not require that to qualify as artificial, an organism must be novel in kind—by which we mean, substantially different in kind (genetically or phenotypically) to any previously or currently existing organism. Had the JCVI’s creation been genetically and phenotypically identical to the wild type *Mycoplasma mycoides*, this would not have affected its artificiality. Second, whether the JCVI bacterium qualifies as artificial, on this definition, will depend on whether the nuclear genome is the only ‘core element’ of a bacterium—an assumption that many biologists would reject, given the crucial developmental and homeostatic role played by various cellular structures in the cytoplasm and membrane. Third, the qualified phrase ‘initially constructed’ is necessary because, once organisms are ‘up and running’, they will frequently be capable of maintaining themselves though exerting a causal influence on their internal and external environment (Saborido, Mossio, & Moreno, 2011). Whereas the parts of rationally designed machines usually wear out with use, organisms will typically renew their parts until death. We take it that if an animal were artificial when first created, it would remain artificial at the end of its life. Fourth, we employ the disjunction ‘or it descended from...’ to accommodate our view that a reproductive lineage descending from an artificial organism or pair of organisms remains artificial in perpetuity since it reflects a continuous causal process that originates in a single artificial creation event (more on this below). And finally, fifth, we note that the above definition of artificiality does not cover domesticated plants and animals that result from selective breeding, or even genetically modified organisms (GMOs), since these are not constructed from chemically simple, non-living materials.

### 1.2. Moral significance

Since we wish to assess the claim that the creation of artificial life is morally significant, it is necessary to say something about how we understand moral significance. There are various ways in which this concept might be understood, but we wish to capture how it has been invoked in discussion of the creation of artificial life. There, the thought has typically been that the creation of artificial life is morally significant in a fundamentally *negative* way. We will take it to have such significance just in case (a) there are moral reasons not to create artificial organisms, or factors that weaken our moral reasons *to* create them, and (b) these are specific to the creation of artificial organisms.<sup>3</sup> The second requirement, holding that the factors which bear negatively on the creation of artificial organisms be specific to this practice, requires some further elucidation. It implies that there are some contrasting practices to which these factors do not apply. But what are those contrasting practices?

The creation of artificial organisms is most naturally contrasted with the much more familiar practices whereby one organism is derived from one or more others. People derive new organisms from pre-existing ones, for example, by engaging in sexual relations with one another, undergoing or providing fertility treatments, harvesting and planting seeds. In some cases, as in most instances of normal human reproduction, the resulting organisms satisfy neither of the conditions for artificiality that we introduced above—they are neither created from chemically simple components, nor created to the specifications of a rational agent. In other cases, the new organisms that we derive from existing ones *are* created to the specification of one or more rational agents who envision a set of desirable organismic properties and manipulate living processes to achieve (or approximate) that end. This is true of domesticated plants and animals developed through selective breeding programs. It is also true of GMOs, as well as organisms that are generated via ‘directed evolution’ in the laboratory, where desirable properties are intentionally selected, rather than engineered in accordance with rational engineering principles (see O’Malley, 2011).

Since the production of new organisms to the specifications of rational agents is already widespread (and indeed has been since the Agricultural Revolution), it would be surprising if those alarmed by the prospect of creating artificial life were alarmed by the created-to-specification aspect of artificial organisms. If they were, it would be difficult to explain why the JCVI’s creation was singled out for attention. It seems more plausible to assume, then, that what alarms some has specifically to do with the fact that artificial life forms would be produced to specification *from chemically simple, non-living components*.

This interpretation is supported by the emphasis that some authors have placed on the claim that creating artificial life is ontologically more radical than the mere derivation or manipulation of living things. Boldt and Müller (2008) put the point this way:

The shift from genetic engineering’s ‘manipulatio’ to synthetic biology’s ‘creatio’ is a shift with considerable ethical significance.... In synthetic biology, the aim is not to amend an organism with a certain quantity of altered characteristics (that is, to manipulate); instead, it is to equip a completely unqualified organism with a new quality of being (that is, to create a new form of life).

The ethically relevant contrast for artificial life, therefore, appears to be the derivation of organisms from other life forms, irrespective of the mode of derivation and regardless of whether it is carried out to human specification.

We can now refine our conditions for moral significance as follows. The creation of artificial life has moral significance just in case (a) there are reasons not to create artificial organisms, or factors which weaken our reasons *to* create them, and (b) these reasons or factors would not apply—or would not apply with equal force—to the derivation of similar life forms from previously existing life forms. ‘Similar organisms’ should be understood as referring to organisms possessing similar non-genealogical properties. ‘Derivation’ should be understood as describing the generation of a new organism through the modification of a continuous causal process (for example, an unbroken chain of reproduction, cellular mitosis, epigenesis, *et cetera*) that extends over space and time.

<sup>1</sup> We use the term ‘organism’ as a term of art here. In common usage, there may be living entities that do not qualify as organisms (such as rainforests) and perhaps also organisms that are not living (such as deceased animals).

<sup>2</sup> The term ‘natural’ is to be read as meaning ‘not supernatural’. This qualification is necessary because without it all organisms would be deemed artificial according to the standard creationist or intelligent design-theoretic view of life, insofar as God is presumed to be a rational agent—a result that is at odds with common usage of the term ‘artificial’. Note also that, as is clear from the definition, we do not take ‘artificial’ to mean inorganic or non-biological, although some might use the term in this way.

<sup>3</sup> Note that it would not follow from the existence of moral reasons not to create artificial life that there is a decisive objection against creating it, since these reasons may be outweighed by moral reasons that speak in favour of creating artificial life.

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