Foundations of Science
https://doi.org/10.1007/s10699-022-09848-y

The ontology of creation: towards a philosophical account of the creation of World in innovation processes

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Accepted: 13 May 2022

Abstract
The starting point of this article is the observation that the emergence of the Anthropocene rehabilitates the need for philosophical reflections on the ontology of technology. In particular, if technological innovations on an ontic level of beings in the world are created, but these innovations at the same time *create* the Anthropocene World at an ontological level, this raises the question how World creation has to be understood. We first identify four problems with the traditional concept of creation: the anthropocentric, ontic and outcome orientation of traditional concepts of creation, as well as its orientation of material fabrication. We subsequently develop a progressive concept of World creation with four characteristics that move beyond the traditional conceptuality: (1) a materialistic concept of creation that accounts for (2) the ontogenetic process and (3) the ontic and ontological nature of creation, and (4) is conceptualized as semantic creation of the World in which we live and act.

Keywords Anthropocene · Creation · Innovation · Technology · World

1 Introduction

Since the emergence of the Anthropocene, classical philosophies of 'Technology with a Capital T' need to be rehabilitated (Lemmens, 2021). Heidegger's (1977) abstract notion of *enframing* as mutual challenging of humanity and nature as standing-reserve for our exploitation in the age of technology for instance becomes concrete in the experience of a planetary technical system in the Anthropocene, which constitutes a *technosphere* (Haff, 2013) or *technocene* (Cera, 2017; Hornborg, 2015). To be clear, we do not conceive the Anthropocene here as an ontic phenomenon, i.e. as a geological epoch that started at a particular moment in time (for instance the Trinity test on 16 July 1945) and can be established by a community of geologists. If we ask what exactly changed in the era of the Anthropocene,

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Published online: 13 June 2022

in contrast to the previous era of the Holocene, these changes are not primarily found at the ontic level of new objects that emerge in times of climate change, but at the ontological level of the transition of our understanding of World as a whole in times of climate change (Zwier and Blok, 2017). In the phenomenological tradition, World is the dimension of the meaningful environment in which I am always already intentionally involved and know how to deal with other human and non-human beings.[1] This meaningful environment is disrupted in times of climate change; climate change disrupts the way in which reality as a whole appears – i.e. the stability of the World as background condition for our living and acting in the world - and the way human being is responsive to this new reality in this new epoch, i.e. the Anthropocene World.

More recently, and contrary to Heidegger's essentialism that focusses solely on the history of Being, it is argued that the Anthropocene World is constituted by a succession of interrelated inventions since the beginning of the industrial revolution (Blok, 2022a). This means that technical evolution at an ontic level has an ontological imprint on the world in which we live and act, whether this imprint is understood as techno*sphere* (Haf, 2013), as technical *culture* (Simondon, 2017), technical *system* (Stiegler, 1998) or Anthropocene *World* (Blok, 2021a). Innovations[2] at an ontic level of beings *in* the world like the steam engine, the telescope or AI applications are *created*, but these innovations at the same time *create* the technosphere or the Anthropocene World at an ontological level (Blok, 2021b).[3]

This idea confronts us however with a problem. How to conceptualize the nature of the *creation* of World at an ontological level?[4] As the Anthropocene World is not of all times but emerges in Earth history at the end of the Holocene, we have to acknowledge that this World is created in one way or another. On the one hand, traditional conceptualizations of creation seem to be inappropriate to characterize the creation of World. For instance, we tend to conceive the creation involved in innovation in anthropocentric terms – i.e. the entrepreneur as innovator (Schumpeter, 1983) – while literature on technological evolution shows that

[1] Although our concept of World and living and acting in the world is definitely inspired by Heidegger's work, we also deviate from his conceptuality in this article, as we criticize his essentialist understanding of World and conveive the Anthropocene World beyond a Heideggerian conceptualization as world-picture embedded in *enframing* (Blok, 2021a).

[2] Although philosophers of technology seem to prefer to speak about invention instead of innovation, as innovation is mainly seen as commercialization of inventions in a free market economy, we use these concepts interchangeably in this article. On the one hand, philosophy consists in the explorative confrontation with prevailing views in science and society (Blok, 2020), and innovation can definitely be seen as an emblem of our time (Godin, 2015). On the other hand, although innovation is often associated with the commercialization of technology, the concept can also cover the conceptuality associated with the notion of invention (Godin, 2015).

[3] From a Heideggerian perspective, the question is whether the Anthropocene can be conceived as new World or merely as world-picture dominated by *enframing*. Although also philosophers like Nancy and Stiegler would not speak of the technosphere in terms of a new World, as they see the technosphere as the *destruction* of World, we have argued elsewhere that also the Anthropocene has to be understood as World (Blok, 2022b). The further discussion of the Anthropocene as World is beyond the scope of this article.

[4] Although we normally talk about world-*making* (Hamilton, 2017) or world-*building* (Heidegger, 1983), we have chosen here for the more neutral concept of world-creation. First, making and building suggests that the world is physically produced, which is not the case as we will show in section three. Second, world-creation is explicitly thematized by philosophers of the post-Anthropocene World, like Hamilton (2017: 63) and Nancy, who explicitly thematizes *The creation of the World* as the title of a recent book (Nancy, 2007). Third, contrary to 'building' and 'forming', the notion of creation has the advantage that it can be applied both the ontic level of beings in the world and on the level of the World in which we live and act. In section two, we also clearly deviate from the religious connotations of the term.

humanity is not its primary subject (Stiegler, 1998); paleontological research shows for instance that the evolution of human being is technologically conditioned (Leroi Gourhan, 1993), leading to the idea that the human is 'invented' by technology (Stiegler, 1998: 158). On the other hand, traditional conceptualizations of creation seem to focus on the innovation outcome at an ontic level, i.e. the production of the first steam engine or machine learning technique. In contemporary philosophy of technology for instance, most analysis is dedicated to the creation, fabrication, and design of artifacts (Kroes, 2012; Vermaas et al., 2011), while we are primarily interested in World-creation at an *ontological* level. And even if the ontological power of technology is acknowledged (Floridi, 2011), it remains unclear how technology at an ontic level 're-ontologizes' World at an ontological level (Floridi, 2013). Even if we conceptualize World creation at an ontological level as the effect of a succession of creations at an ontic level like the steam engine, the nature of this *creation* of the Anthropocene World remains unclear.

If we want to reflect on the nature of creation in the case of World-creation, we should move beyond the traditional concept. In this article, we therefore reject both the anthropocentric, religious and ontic orientation of the concept of creation and ask what is the nature of creation involved in World creation. We develop a non-anthropocentric but materialistic concept of creation, which is not only outcome but also process oriented and covers not only the ontic but also the ontological dimension of creation. Although human creativity is decentred, it will become clear that the creative consciousness of human living and acting in the world is not completely excluded from World creation, as human creation embodies the materiality of World creation.

In section two, we first critically reflect on traditional conceptualizations of the process of creation. We criticize the anthropocentric, ontic and outcome orientation of traditional concepts of creation, as well as its orientation of material fabrication. In section three, we develop a progressive concept of creation with four characteristics that move beyond the traditional conceptuality. We develop (1) a materialistic concept of creation that accounts for (2) the ontogenetic process and (3) the ontic and ontological nature of creation, and (4) conceptualizes it as metaphysical semantics of the world in which we live and act. In section four, we draw our conclusions.

2 Critical reflection on traditional conceptualizations of the process of creation

In this section, we first question the classical understanding of creation and its limits in the context of the creative process involved in World creation.

Traditionally, the starting point of our understanding of the creative process is found in the subject of creation – i.e. the creator – or the object of creation – i.e. the created artifact. The process of creation is for instance understood from the perspective of four causes: the material, formal, final and efficient cause (Aristotle, 1980). In his *Physics*, Aristotle distinguishes between natural beings, who have the origin of their emergence and decay in themselves, and artificial beings, which have the origin of their emergence and decay in an external agent. Artificial beings are created by a craftsman who is the efficient cause of their creation. We define the anthropocentric concept of creation as one that sees the human as primary subject of creation.

If we find our point of departure in the creator, we conceive the creative process as process of production, making or designing of the created artifact – i.e. the first machine learning or deep learning technique – that is guided by the craftsman's knowledge (*technè)* of this idea of machine learning (Heidegger, 1979), the final cause and the formal cause that guide the production of the first machine learning technique in the world. But this conceptualization of the process of creation is problematic in case of disruptive innovations like the first deep learning technique, as they do not pre-exist as ideas represented by the creator, but emerge for the first time as an *outcome* of the creative process. Disruptive innovations like machine learning and deep learning techniques, but one can also think of the first steam engine or the first telescope, are in the first instance *un*-known, i.e., artifacts we are unfamiliar with because they disrupt what is known and introduce something *new*-to-the-world (Blok, 2021b).

We could solve this problem by arguing that the creative process involved in innovation can be understood in terms of a new idea (for example, the idea of machine or deep learning techniques) – its formal cause and final cause – by an external agent, who subsequently guides the creation of the first deep learning technique. Floridi for instance defines humans as poietic creatures, demiurges who create new ideas (Floridi, 2013). We call this an idealistic concept of innovation. Innovations like the steam engine, the telescope and deep learning techniques are then understood as *creatio ex nihilo* by the human subject, who primarily creates this new idea from nothing. This solution raises new problems, however. First, if the process of innovation is understood as such a creation ex nihilo, this nihil of the material cause misses the reality of technological evolution, which is never absolutely novel but always determined by previous stages of development and interdependencies with other technological developments (i.e. the availability of complex alloys and advanced production facilities). In other words, there is no innovation without its historical emergence in the world independently of human creation.[5] Next to the intentional aspect of creation – i.e., deep learning techniques are designed with a particular purpose or goal in mind – the material and structural aspect of creation needs to be acknowledged. These can be conceived as intrinsic universal technical tendencies which are independent of the creative agent but are operationalized in concrete technologies in relation to particular cultural and environmental settings (Simondon, 2017; Stiegler, 1998).

Another issue with the anthropocentric orientation of our concept of creation *ex nihilo* by the human subject is the presupposition that the subject of creation pre-exists the innovation as a free agent who creates an artifact which is new to the world. It privileges the subjective role of the creative agent, modelled after Plato's demiurge – the craftsman who creates the world – and the transcendental position of God in monotheistic theology. This transcendental position of the subject of creation is problematic, however. Either this subject is characterized by historically embedded motives and intentions that affect the creative process, which would contradict the idea of a creation *ex nihilo*, or the subject is so self-sufficient that it raises the question why this subject should create anything at all.

In fact, the human subject does not have such a transcendental position. As indicated already in the introduction, palaeoanthropology teaches us that innovations are not so much

[5] The idea that only natural creation is capable of creating new to the world living beings, while human creation depends on material conditions to build a house or a statue, an idea that can be found in the work of Aquinas (1952), doesn't hold anymore. Since the emergence of Darwinism, we know that both natural and artificial evolution is dependent on environmental conditions.

invented by humans, but that the nature of what it means to be human is affected by the co-evolution of the upright skeleton, the use of tools and language (Leroi-Gourhan, 1993). Some authors tend to fall in the other extreme and argue for a totally autonomous technicity that doesn't require any creative consciousness but only a technical consciousness to realize the possibilities provided by technologies (Ellul, 1964) or argue that the age of technology is a destiny outside human control (Heidegger, 1977). Even if we reject such a radical technocentric instead of anthropocentric concept of creation and argue for a relation of equation in the co-creation of the World in which we are always already intentionally involved, this immanent position of our existence in this World fundamentally limits the idea of a creation *ex nihilo* by the transcendental position of the human subject of creation. In other words, humanity is not the subject of World creation and does not have a transcendental position from which it innovates since disruptive innovations like the telescope or AI disrupt not only our understanding of the object but also of the human subject. The example of the invention of the telescope can illustrate this radical immanence of our existence in this creative process.

Galileo's innovation of the telescope extended for the first time the human senses to the universe beyond the world as we know it, which was inaccessible before. At the same time, however, it disrupted our relation to the world as it destroyed the geocentric orientation of our living and acting in the world and replaced it with a heliocentric orientation of our existence in the world. The Earth emerges from now on as a star among the other stars in an infinite and unified universe, to which the same universal laws of nature apply (Koyré, 1958). Thanks to the technical mediation of the telescope, the universe became accessible 'with the certainty of sense-perception', which was previously only accessible in speculation and imagination (Arendt, 1958: 260). At the same time, thanks to the technical mediation of the telescope, humans became astral as they found a new Archimedean point in the universe outside the world. It constituted a new orientation for human existence, a living and acting in the world *as if* humanity manages and controls the planet from outside, leading to the Anthropocene World in which humanity is threatened by global warming today.

What the example of the telescope makes clear is that disruptive innovations like these change 'the rules of the game' (Schumpeter, 1983), or in more philosophical terms, destroy the geocentric World and create the heliocentric World. World creation involves a transformation of being and thinking at once, and can therefore not be initiated by thinking of a subject of this creation. At the same time, although humans are not the creative subject of innovation, the innovation of our World is also not an autonomous process since it is also not *without* human creativity; human living and acting in the world participates in innovation, for instance in their operation, regulation, and usage. This World concerns a meaningful whole *as* heliocentric orientation of our living and acting in the world in which the human subject is *included* and no transcendental position of the subject of innovation is possible.[6]

[6] With this affection of the creative consciousness by disruptive innovations, we can also question another theological motive in the traditional conceptualization of creation, namely that the creator disappears in the process of creation (Nancy, 2007). Prefigured already in Heraclitus' famous thesis that nature has the tendency to conceal itself (Heraclitus, fragment 123), we encounter this idea in the old testament where it is argued that God creates the world and everything in it and at the same time withdraws from it in this act of creation. We also find this motive in Aristotle's idea that *steresis* or absencing belongs to the self-emergence of nature and in Levinas' idea that the being that is in relation with another being *absolves* itself from this relation (Levinas, 1969). We can even argue that this theological motive determines Heidegger's idea that the destining (*Geschick)* of enframing in the age of technology, in which the question of being is completely forgotten, remains embedded in an *abandonment* of being (Heidegger, 1989).

This ontological imprint of innovations on the level of World is already acknowledged in early reflections on innovation. Polybius (200 – 118 BCE), who can be seen as the father of the study of objective history, is an early writer about innovation (*kainotomia*). He doesn't conceive the creative process involved in innovation at the level of artifacts, but at the level of the "whole world [entering] a new phase" (cited in: Godin 2015). A contemporary example can be found in the work of Floridi, who argues that information technologies *re-ontologize* the world, i.e. create a new reality with new ideas, new concepts and unprecedented problems (Floridi, 2011). Innovations disrupt not only our understanding of the object but also of the subject of innovation, which means that we are in need of a concept of creation that enables us to conceive the process of creation from the perspective of the technical system or World that is disrupted and the new World which is created by these innovations (Blok, 2021a).

With this, we encounter a second problem with the traditional concept of creation. We are used to conceive the outcome of the process of creation at the ontic level of an artefact – i.e. the innovation of the first telescope or deep learning technique – while the creation of this innovative outcome has an ontological imprint on our World at an ontological level. As long as the point of departure is found in the created artifact as the ontic outcome of creation, our concept of creation misses the ontological level of World-creation.

This problem may convince us to radically distinguish between the two levels of creation, one being at the ontic level of the artifact – i.e. the telescope – and the other at the ontological level of World – i.e. the heliocentric orientation of our living and acting in the world - and concentrate on the creation of World at this ontological level, which is incommensurable with the creation of artifacts at an ontic level. Philosophers like Jean-Luc Nancy for instance argue for the *facticity* of the World, which is created *ex nihilo*, as the meaning of World is created but not by any principle on which it is grounded; "neither reason nor ground sustains the world" (Nancy, 2007: 120). We can however question Nancy's essentialist or onto-centric orientation of the creation of World as creation *ex nihilo* in which the ontic level of creation is neglected. Why? Disruptive innovations at an ontic level – i.e. the telescope - disrupt our geo-centric living and acting in the world and create our heliocentric World at an ontological level. These disruptive innovations at an ontic level are indeed not the *cause* of the disruption of our World, and are not created from a material cause by a human or non-human producer as we have seen. And yet, disruptive innovations like the telescope have a formative power to *found* our heliocentric World at an ontological level (Blok, 2022a). The innovation of the telescope at an ontic level involves the innovation of our World at an ontological level, and therefore, the creation of the World cannot be conceived as creation *ex nihilo.* Just as we have to reject a unilateral ontic orientation of creation on the artifact as the outcome of creation, we have to reject any unilateral ontological orientation in favour of an ontic-ontological concept of creation involved in innovation.

The acknowledgement of the ontic-ontological level of creation introduces however a third problem with the traditional concept of creation. Negatively said, if innovation creates our World, the creation involved in World creation cannot be understood in analogy with the ontic creation involved in the innovation of beings *in* this world. The creation of the telescope creates the heliocentric World, but while the creation of the first telescope can be understood as fabrication of a new artifact based on pre-existing materials like its predecessor (e.g. the ocular lens), the creation of the heliocentric World is not 'fabricated' based on pre-existing material, but concerns a radically new meaning of our World. It also

doesn't help to conceptualize the nature of this creation in analogy with natural evolution, i.e. as historically constituted by its evolvement out of various complementary predecessors (Gille, 1986), as we run the risk that our conceptuality remains solely oriented on a history of innerworldly or *physical* artifacts in the world. And if we conceptualize the nature of the creation in analogy with thermodynamics, i.e. as constituted in the strife between entropy and negentropy (Stiegler, 2021), the risk is that our conceptuality remains solely oriented on *physical* phenomena *in* the Anthropocene World (Blok, 2021b). For this reason, we are in need of a *meta-physical* perspective on the process of creation involved in the creation of World.

With this, we encounter a fourth and final problem with the traditional concept of creation. As long as the point of departure is found in the creative outcome, whether this outcome is understood at the ontic level of the artifact or at the ontological level of World, we miss the ontogenetic *process* of creation. If our point of departure is found in the outcome of innovation, whether we conceive this outcome at an ontic level of the telescope or the ontological level of our heliocentric World, we miss that innovation concerns both a process – i.e. the process of innovation - and the innovative outcome of this process. As the outcome of the innovation process can be considered an *individual* artifact– i.e. the first deep learning technique, telescope or blockchain– or *singular* articulation of our World - we can conceive the innovation process as the *pre*-individual ontogenesis leading to this outcome of innovation (Simondon, 2017). This ontogenetic *process* of innovation cannot be understood from its outcome because then the process of innovation – pre-individual - is conceptualized based on its outcome – individual - and not in terms of the process itself (Blok 2021b). This ontogenetic process *precedes* the innovative outcome, and for this reason, the outcome never provides access to this preceding process. If the outcome of the innovation process is the point of departure, we miss the *ontogenetic* process that *creates* this outcome. This means that the creative process should not be thought of from the perspective of the creative outcome but from the perspective of this pre-individual process of creation.

To sum up, there are four problems with the traditional conceptualization of creation: (1) creation is traditionally understood as creation *ex nihilo* by the human subject who freely creates this artifact and transcends this artifact. This anthropocentric orientation neglects the material reality of innovations that disrupt our being-in-the world and in which human creativity is involved but does not allow for a transcendental position. We are therefore in need of a non-anthropocentric but materialistic concept of creation in which both the material and structural aspects as well as the intentional aspects of creation are acknowledged; (2) creation is traditionally understood from the point of view of the outcome of innovation, while creation involves both an outcome and a process. We are in need of a concept of creation that finds its point of departure in the ontogenetic process at stake in creation; (3) creation is traditionally understood from the point of view of the created artifact at an ontic level, while our concept of creation should account for both the ontic and ontological level of the creation of our World. The problem of a unilateral ontic or ontological conceptualization of creation is that it misses the ontic-ontological nature of the creation involved in the innovation of our World; (4) creation is traditionally understood intentionally as fabrication or design based on pre-existing matter, while the creation of World does not involve any fabrication or design from pre-existing material but concerns the creation of a radical new meaning of our World. We are hence in need of a metaphysical semantics of creation.

These four problems have to be solved by a philosophical account of the nature of creation involved in disruptive innovation as creation of World.

3 Towards a materialistic, ontic-ontological, process and semantic oriented concept of creation

The starting point for our reflections on the nature of creation involved in disruptive innovations is their *inorganic materiality.* With this, we do not so much embrace Aristotle's categorial divide between natural and artificial beings (§ 2). Today's technological developments in synthetic biology and production of 'living machines' show the limitations of such a categorial divide (Holy-Luczaj & Blok, 2019). The notion of inorganic materiality enables us however to initially distinguish between genetically programmed biological evolution and non-genetically programmed technological evolution, without assuming a priori a continuity between the two processes of creation.[7]

The inorganic materiality of disruptive innovations can serve as an alternative starting point for the anthropocentric orientation of the traditional concept of creation (problem 1) and may characterize the creation involved in innovations like the steam engine or deep learning techniques. A critical reader would argue however that inorganic material cannot sufficiently account for the *initiation* of the creative process and evolution involved in technological evolution. In the philosophical tradition, materiality is often understood in its inert substantiality, ranging from Aristotle's *hulè* to Descartes *res extensa*, which then requires an external agent to initiate and drive the process of creation, i.e. the artisan as subject of creation. And yet, it is not necessary to adhere to such an anthropocentric conceptualization of an external agent that fabricates an artifact out of this material substance. We can question whether inorganic materiality can be understood in terms of a *res extensa*, as the stretching out (*extensio*) can fan out in all directions and cannot account for the unity of that thing. For this reason, philosophers like Spinoza argued that "each thing, as far as it can by its own power, strives *[conatur]* to persevere in its own being" (Spinoza, 1992: part 3, proposition 6). Each being, not only organic beings but also inorganic material beings, are characterized by the tendency toward self-preservation. This idea, that not only organic beings but all material beings have agency, is increasingly accepted in philosophy (Latour: 1993); everything is conative, ranging from stones and trees, humans and technologies (Bennett: 2010). If the starting point of our metaphysical reflection on the nature of creation is found in the inorganic materiality of innovations, the principle of conativity of all beings enables us to move beyond the traditional anthropocentric conceptualization of creation (i.e. problem 1).

The principle of conativity enables us to conceive the creation involved in disruptive innovations as an ontogenetic process of the preservation of the identity of a new-to-the-world innovation, i.e., the emergence of the new-to-the-world identity of the telescope next to its first material instantiation in a new-to-the-world artifact. Why? Conativity is not so much an ontic will or impulse of material beings towards self-preservation, but an ontologi-

[7] In fact, the further analysis of the commonality or difference between natural and technological evolution is beyond the scope of this article. Aristotle for instance argues that the artist creates an artefact *as* nature creates natural beings (Aristotle, 1980: 194a20-25). Others, like Simondon (2017), see a fundamental difference between these processes. We are hesitant to accept either explanation however as long as the nature of creation involved in innovation is not sufficiently conceptualized, which is the main aim of this article.

cal principle that establishes the *identity* or *meaning* of these beings (BLok, 2016); "The conatus to preserve itself is the very *essence* of a thing" (Spinoza, 1992: part 3, proposition 7)(emphasis added). Conativity does not indicate the preservation of a being in its own existence, but concerns the ontogenetic process in which the identity of a new-to-the-world material object like the telescope is constituted. This is why the conativity of creation does not imply a new form of animism that argues for the agency or will of innovations like the steam engine to explain its emergence. The 'steam engine' as an artefact is not primarily conative, but the identity of the steam engine is the performative constituent of the principle of conativity, which is characteristic of the process of creation. The conativity of creation explains the invention of the new-to-the-world identity of innovations beyond the given reality. It creates this new-to-the-world *identity* of the innovation in the production of its first physical instantiation. The principle of conativity is the first characteristic of our concept of creation, which solves the problem of anthropocentrism in the traditional concept of creation.

The second problem we encountered in the previous section concerned how our understanding of creation is oriented toward the outcome of innovation. The advantage of the principle of conativity is that it enables us to shift our attention from the outcome to the process of creation. If the principle of conativity characterizes the ontogenetic process of *self*-preservation that characterizes all material beings, this *self* or identity is not something given as an outcome of creation. On the contrary, the differentiation of the self implies that matter is in the first instance un-differentiated, non-self. All material beings we encounter in the world are differentiated modifications of the un-differentiated materiality that constitutes the universe.[8] As a differentiated modification of undifferentiated materiality (*self*-perseverance), each material entity is resistant to everything that can take its existence away (self-*perseverance)*, and this resistance consists precisely in the conativity to preserve oneself as such a modification of undifferentiated materiality. Conativity is an endeavouring, an effort, and characterizes the ontogenetic process of creation that differentiates the identity or meaning of material entities like stones and trees, humans, and technologies from undifferentiated materiality; it articulates and establishes the identity of material entities and prevents at the same time their relapse into this undifferentiated materiality.

If we consider the conativity of creation in the context of innovation, we can conceive the process of creation as the differentiation of a new-to-the-world identity that emerges from this undifferentiated materiality. We can conceive this process as the creation of an excess or *surplus* beyond undifferentiated materiality, i.e., the new identity of something new-to-the-world that didn't exist before, such as the first steam engine, telescope or deep learning technique. This creation of the identity of the innovation is needed since without it, the conativity of creation would fan out in all directions and could not account for the unity of the new identity of the innovation. To the extent that the conativity of creation does not only consist in *self*-perseverance but also resists everything that can take its new-to-the-world identity away (self-*perseverance)*, this newly created identity of the innovation at the same time *deviates* from what is existent in the world.

How can this deviation of creation be conceptualized? In the history of technology, we observe a discontinuity between waves of technological development (Kondratieff, 1935),

[8] Although we deviate in this from philosophers like Gotthard Günther and Gilbert Simondon who assume that matter is always already (in)formed, the further discussion of this issue is beyond the scope of this article (cf. Blok, 2017).

for instance the wave starting around 1845 associated with steam power, which follows the wave associated with waterpower and gave rise to inventions like the water mill and the emergence of the textile industry. The invention of the steam engine does not only establish a new to the world identity, namely the first steam engine, but this creation concurrently deviates from everything that is associated with what we could call the 'world of water', i.e. the water mill. The conativity of creation appropriates the new-to-the-world identity of the steam engine (*self*-perseverance) and deviates this new-to-the-world identity from the existent – i.e., everything that belongs to the world of water - in order to persevere in its own existence (self-*preservation)*. This deviation of the surplus is simultaneously positive, as the conativity of creation appropriates an eruption of a new to the world possibility of the identity of the created (*self*-perseverance), and negative, as the deviation of creation frees this newly created identity from the inhibiting forces of the existent (self-*perseverance*).[9]

If the starting point of our metaphysical reflection on the nature of creation is found in the principle of conativity, the onto-genetic process of the creation of the identity of the new-to-the-world innovation as deviation from the existent enables us to move beyond the traditional orientation on the outcome of innovation (problem 2). The outcome of innovation turns out to be the *trait d'union* of the process of creation of the identity of the new-to-the-world innovation and its deviation from the existent, as it establishes the new-to-the-world identity and puts itself outside the range of the existent at the same time. The ontogenetic process of creation is the second characteristic of a materialistic concept of creation. It solves the problem of how the traditional concept of creation is orientated toward the outcome of innovation.

The first advantage of this characteristic of creation is that it opens our perspective on the unpredictable event of creation. In science and technology studies, we tend to focus on the outcome of the process of innovation because its risks and benefits can be calculated. As soon as we see the ontogenetic process of creation involved in innovation, however, we can no longer neglect the unpredictable event of creation beyond human control. The ontogenetic process of creation accounts for the fundamental uncertainty and unpredictability of the imprint of disruptive innovations. The second advantage of this characteristic of creation is that the deviation of the surplus of creation accounts for the subversive nature of innovation, its potentiality to overthrow the existing order, which is acknowledged throughout the history of innovation (Godin, 2015). With the unpredictability and subversive nature of innovation, we encounter a third advantage. We can accept that inventions like the steam engine disrupt the world in which we live, without automatically adopting the idea of technological determinism. In fact, and this is the fourth advantage of this characteristic of creation, it provides a concept of the *new* involved in innovations. While traditional concepts of innovation see novelty and newness as central characteristics, they see it ultimately as a relative concept, ranging from new-to-the-world to new-to-the-company innovations (Cooper, 1993). Our concept of creation provides a qualitative definition of the new. The deviation of the surplus of creation defines the new as appropriation of the identity *as* deviated from the existent, and accounts for the new-to-the-world character of these outcomes of innovations.

Does the ontogenetic process of creation also provide insights into how the outcomes of innovation imprint our World at an ontological level (problem 3)? To see this, we return for

[9] Because this deviation is both positive *and* negative, it cannot be associated with the alienation of an 'original' or 'natural state', the self-alienation so often associated with technological innovation (Rousseau, 1973).

a moment to the history of innovation. The creation of disruptive innovations is not a one-off event that is only driven by the principle of conativity, as innovations are at the same time *responsive* to the material and human conditions that make them possible. For example, the invention of the steam engine is responsive to preceding innovations. Newcomen's invention of the atmospheric steam engine for instance is partly dependent on earlier inventions like the steam turbine and the steam pump. Second, its invention is responsive to complementary innovations. The components of the steam engine like the piston and cylinder co-evolve and are responsive to each other in their convergence in the steam engine. Third, the innovation of the steam engine is responsive to the environment of material conditions, e.g., the availability of iron to build the steam boiler and coal to fuel the steam engine. These conditions already show that the process of creation is not necessarily driven by the human agent as creator, but that the conativity of creation is at the same time *responsive* to these conditions. This responsiveness of creation is also indicated in the fact that not everything is possible in creation. There is no infinity of possible designs of the steam engine, because its actual invention and evolution is not only due to the conativity of creation but also responsive to a limited number of opportunities provided by the environment with which the steam engine co-evolves and in which it remains embedded for its proper operation and functioning. Without the discovery of the coal mines for instance, the invention and evolution of the steam engine wouldn't come off the ground.

This responsiveness to the environment makes clear that the principle of conativity does not imply that the creation of the identity of new-to-the-world innovations is autonomous, independent, or free, as they are at the same time responsive to the environment in which they emergence and evolve. In this regard, the principle of conativity as first characteristic of a materialistic concept of creation should be supplemented by a principle of *responsiveness*, as the process of conative creation is not free floating but is at the same time responsive to the environment in its constitution of new-to-the-world innovations like the steam engine.

We can conceive this environment as a 'World' suitable for the invention and evolution of the steam engine. In the phenomenological tradition, World is not a being or the totality of beings in the world but concerns the meaningful environment in which beings have their proper place, including our human living and acting in the world. We currently live for instance in a World associated with digital networks. In this World, new inventions like deep learning and machine learning techniques can emerge and can be applied in various software applications, but they can also raise societal concerns regarding surveillance and control. This distinction between the ontic level of new-to-the-world innovations like AI and the ontological level of the digital World on which this innovation depends enables us to conceive how the conativity of creation imprints the ontological level of our living and acting in the world. To see this, we return for a moment to the example of the invention of the steam engine.

As we have seen, the invention of the steam engine deviates from the World of water associated with the water mill. In fact, the steam engine is responsive to a World of steam, i.e., a world in which the environment appears as potential resource (iron), fuel (coal) or operator (worker) of the steam engine. At the same time, the responsive conativity of the creation of the steam engine conditions the "birth of [this] milieu", as Simondon would argue (2017: 58). The World of steam which conditions the innovation of the steam engine only exists virtually before its invention. Before its invention, it was not so much the World of steam that informed the process of creation, but the World of water that inspired techno-

logical developments like the water mill and the accompanying textile industry. On the one hand, the invention of the steam engine deviates from the inhibiting forces of the existent on the ontic level – e.g., existing water mills, the extinction of forests - but more important, from the inhibiting forces of the existent on an ontological level - e.g., the World of water. On the other hand, the invention of the steam engine *founds* a new World of steam, in which coal mines are discovered to fuel the steam engines and all kinds of artifacts appear *as* its predecessor; the piston and cylinder appear *as* a coherent whole in their convergence in the steam engine, the natural environment appears *as* potential resource to build (iron), fuel (coal) or operate (worker) the steam engine etc. This *founding* of the World of steam by the invention of the steam engine discloses the World in a new way and provides new opportunities for our living and acting in the world – for instance the invention of the steam digester as a more efficient energy converter, the development of thermodynamics etc. – while it closes off other possibilities of our living and acting in the world, a return to the World of water for instance. In other words, the founding of the World of steam by the invention of the steam engine founds a *nomos* that regulates the future development and operation of our being-in-the-steam-world. This regulation of our living and acting in the world by the founding of the World of steam doesn't have to be assessed in a negative way, take Jacques Ellul's concept of *technique* as regulation of human behaviour (Ellul, 1964), here, regulation primarily discloses the World as a playing field for human and non-human living and acting in the world (cf. Oudemans, 2012: 104).

With this, it becomes clear that the process of creation is not only characterized by the responsive conativity of creation that creates the identity of new-to-the-world innovations like the steam engine, as this outcome of creation at the ontic level at the same time *founds* a World at an ontological level, from which the proper functioning and operation of the steam engine on the ontic level springs forth. But if the invention of the steam engine founds the World of steam which in turn is the condition of possibility of the proper functioning and operation of this new to the world innovation, the founding of the World of steam by the invention of the steam engine founds its own condition for its existence in the world.[10] In other words, the responsive conativity of the creation of the steam engine on an ontic level *founds* the World of steam which is at the same time the condition of possibility of the proper functioning of this innovation and is therefore already *grounded* in this World.[11] This interdependency between the founding of the World of steam and the grounding in this World for its proper operation and functioning shows that the steam engine's existence in the world-of-steam is not founded once and for all with the invention of the steam engine, but is performatively constituted in the act of its invention, co-evolvement, functioning and operating. The ontic-ontological orientation of the responsive conativity of creation is the third characteristic of a materialistic concept of creation that solves the problem of the ontic orientation on the creation of artifacts in traditional concepts of creation. Contrary to philosophers like Jean-Luc Nancy, who argue that there is no principle of World (Nancy, 2007: 46), this characteristic of creation enables us to conceive the creation of the identity of a

[10] Although we are inspired by Simondon's work in this, we deviate from his analysis as we provide an ontological conceptualization of the relation between the invention and the milieu or World it founds and is grounded in.

[11] For a further elaboration of the mutual relation between the founding and grounding at stake in World creation, see Blok (2022a).

new-to-the-world innovation as the ontic principle of the deviation from the existing World and founding of and grounding in a new World on an ontological level.

The deviation of creation from the existing World by the founding of and grounding in a new World can explain why innovation is often associated with *creative destruction* in innovation economics; innovations do not only create a new-to-the-world artifact like the steam engine, but with this invention, they at the same time destruct the existing market and establish a new market. According to economists like Schumpeter (1983), the invention of the steam engine destroyed the market of the water mill and created at the same time a completely new market for the steam engine. Our philosophical reflection on the responsive conativity of creation enables us to reconceptualize the economic concept of creative destruction at an ontological concept, i.e., as creative deviation of the existing World and simultaneous creative founding of and grounding in a new World.

There are several advantages of such an ontological reconceptualization of creative destruction as deviation, founding of and grounding in World. First, while innovation economics concentrate on the economic impact of creation, our ontological concept of creation enables us to move beyond the economic world (market) and to conceive the impact of new-to-the-world innovations beyond the economic paradigm at an ontological level, i.e., at the level of the 'creative deviation' of our World as such. It enables us to move beyond the economic paradigm of innovation (*neg-otium)* in which it is mainly seen as a driver of profitability and growth, and opens a societal perspective on innovation as a playful process concerned with the free exploration (*otium)* of new-to-the-world innovations, which found not only a private but primarily a public World. We call this the otium of creation. Second, while innovation economics cannot explain the unity of creation and destruction at stake in innovation, we suggest the principle of responsive conativity of creation to explain the unity of creative destruction as deviation of the existent World by founding of and grounding in a new World. Third, while Simondon acknowledges the responsiveness of creation to the environment beyond the economic conditions, he only focuses on the constructive and not on the destructive side of innovation (Simondon, 2017: 21). Contrary to conceptualizations of innovation that unilaterally focus on the destructive aspects of innovation, like Plato and Aristotle (Godin, 2015), or on the constructive aspects of innovation like Simondon (2017), our ontological concept of creation enables us to acknowledge both destructive and constructive aspects as deviation from the existing World by founding of and grounding in a new World.

The fourth problem of the traditional concept of creation was its orientation on the fabrication and making from pre-existing material. On the one hand, we have to acknowledge this material aspect of creation as we have seen. The responsive conativity of creation creates the identity of new to the world innovations *in its first material instantiation in a new-to-the-world artefact.* In this respect, the creation of this new to the world identity is intrinsically bound to a material creation of a new to the world artifact as instantiation of this new identity. At the same time, it is clear that creation as fabrication of pre-existing material is insufficient to understand the ontological imprint of this material creation on the creation of World. The new to the world steam engine deviates from the existing World of water by founding a new World of steam at an ontological level, but this creation of World at an ontological level doesn't involve any fabrication – fabrication is limited to the making of *beings* in the world while creation involves also our *living* and *acting* in the world at an ontological level – nor any material destruction or construction – the invention of the steam

engine doesn't necessarily involve the physical destruction of water mills in the world. The deviation of the surplus of creation doesn't concern a *material* deviation – as if the invention of the steam engine physically destructs all windmills in the world – or *material* surplus – as if the World of steam is itself a being that we can find in the world – but concerns a *semantic* creation of the meaning of this new to the world innovation for our living and acting in the world. This creation of meaning consists in the semantic deviation from the meaning

Table 1 four problems of the traditional concept of creation and four characteristics of a materialistic concept of creation

Traditional concept of creation	Limitations to understand creation involved in innovation processes.	Materialistic concept of creation	Advantages to understand creation involved in innovation processes.
1) Anthropo-centric orientation on human creation *ex nihilo.*	- Creation *ex nihilo* cannot account for the evolutionary dimension of innovation. - Creator's transcendental position cannot account for his or her historical embedded motives and intentions. - Creator's transcendental position cannot account for his or her immanence in the innovation of our World.	1) Material orientation on the conativity of creation.	- The conativity of creation accounts for the ontogenetic process of the identity of new-to-the-world innovations.
2) Orientation on the outcome of creation.	- Cannot account for the ontogenetic process of creation.	2) Orientation on the ontogenetic process of creation; the outcome of creation is the *trait d'union* between the process of creation of the identity of the new-to-the-world innovation and its deviation from the existent.	- The ontogenetic process of creation accounts for the unexpected and unpredictable event of creation. - The ontogenetic process of creation accounts for the subversivity of innovation. - The ontogenetic process of creation accounts for 'the New' in terms of the appropriation of the surplus of creation *as* deviation from the existent. - The acknowledgement of the ontogenetic process of creation enables to move beyond technological determinism.
3) Ontic orientation on the creation of the artifact.	- Cannot account for the ontic-ontological level of creation involved in disruptive innovations of our World.	2) Ontological orientation on the *responsive* conativity of creation as deviation, founding of and grounding in World.	- The ontic-ontological orientation of creation enables to move beyond an economic paradigm of innovation and consider its imprint on our World. - The ontic-ontological orientation of creation can explain the unity of creative destruction as deviation and founding/grounding of World. - The ontic-ontological orientation of creation accounts for both the destructive and constructive aspects of creation.
4) Orientation on fabrication and making from pre-existing material.	- Cannot account for the creation of World, which doesn't involve any material fabrication.	- Orientation on material fabrication on an ontic level *and* semantic creation on an ontological level.	- The orientation of fabrication of innovations on an ontic level and semantics of creation on an ontological level enables us to acknowledge a material principle of World creation.

of our living and acting in the world-of-water and semantic founding of and grounding in the meaning of our living and acting in the world-of-steam. In other worlds, while the steam engine can be seen as the material trait d'union of the process of creation of the identity of the new-to-the-world innovation and its deviation from the existent, the deviation from, founding of and grounding in World is not material but semantic by nature. The fourth characteristic of our materialistic concept of creation is its material-semantic nature, which acknowledges both the *materiality* of creation of new-to-the-world innovation *and* the semantic imprint of its deviation, founding and grounding of World.

The advantage of the acknowledgement of the material *and* semantic dimension of creation is that we do not have to accept an ontocentric concept of creation of World (Nancy, 2007), and acknowledge the interdependency of te material-ontic and the semantic-ontological level of creation. It enables us to acknowledge that the founding of the steam World can be guided by a material trace of a pre-existing innovation not yet embedded in the World of steam – for instance the aeoliple, a preliminary steam turbine that was found in the first century in Egypt (Alexandrinus, 1998) – and that this World of steam can be disrupted by future material innovations, i.e. the combustion engine. In other words, it is the responsive conativity of creation, which characterizes inorganic matter, that can be seen as material principle of World creation.

4 Conclusion

We started this article with the observation that the emergence of the Anthropocene rehabilitates philosophical reflections on the technosphere or Anthropocene World at an ontological level. We concentrated on the nature of creation involved in World creation. We raised the question how the nature of the creation of World has to be understood. We first identified four problems with the traditional concept of creation: the anthropocentric, ontic and outcome orientation of traditional concepts of creation, as well as its orientation of material fabrication (§ 2). We subsequently developed a progressive concept of creation with four characteristics that move beyond the traditional conceptuality: (1) a materialistic concept of creation that accounts for (2) the ontogenetic process and (3) the ontic and ontological nature of creation, and (4) conceptualizes it as semantic creation of our living and acting in the world (§ 3).

The main problems of the traditional concept of creation and four characteristics of a materialistic concept of creation are summarized in Table 1, including particular advantages of this conceptuality for contemporary discussions about creation, invention, and innovation.

With this non-anthropocentric but materialistic concept of creation that accounts for the creation of World at on ontological level, we can move beyond the intrinsic connection between creation involved in disruptive innovations and *hubris.* The classical idea is that the capacity to create is a divine one but stolen by humans. By engaging in creation, humans pretend to be godlike and move beyond their human nature, but in return, the outcome of this creation will turn against them. Seen from this perspective, the contemporary climate crisis is taken as punishment for the technological societies we created since the industrial revolution, and have led to the environmental distress in the Anthropocene.

Our materialistic concept of creation enables us to disconnect creation and hubris, as creation is not something particularly divine or human (§ 2), but embedded in the conativity of inorganic materiality (§ 3). The responsive conativity of creation creates a new-to-the-world innovation that deviates indeed from the existing World, but this deviation is in no way a punishment for our technological societies in which no room for World seems to be left (Nancy, 2007). On the contrary, the deviation of the existing World doesn't imply the end of the World (Blok, 2021a) but is accompanied by a founding of and grounding in a new – Anthropocene – World. In this regard, our materialistic concept of creation enables us to move beyond a pessimistic or even apocalyptic vision that the climate destruction today may no longer provide new opportunities to create a new - post-Anthropocene - World.

Does our disconnection of creation and hubris lead to the ecomodernist position, i.e. the idea that the climate crisis is not the result of techno-industrial hubris, but an indicator of the capacity of humans to control nature (Hamilton, 2016)? Although our concept of creation moves beyond a hubristic concept of creation, it also moves beyond the ecomodernist idea of human control of nature. In fact, our concept of creation is incompatible with ecomodernism, as it rejects both the human as subject of creation and the materiality of nature as something under human control.

Although humanity is not the subject of World creation, the founding of and grounding in World is also not without human involvement, as this World is performatively constituted in the act of invention, co-evolvement, functioning and operation in which human living and acting in the world is involved. Now we have opened a non-anthropocentric but materialistic concept of creation in this article, we may ask how exactly human creation is involved in this process of creation. On the one hand, we could explore the materiality of humans to conceive the involvement of *human* conativity in the responsive conativity of the creation of World. On the other hand, we could explore the principle possibility of *human* deviation of any imposed *nomos* or regulation of World, whether we find the particular human deviation in their act of in-human behaviour, in their act of transgression or in their act of revolution. These explorations, which are opened by the materialistic concept of creation we developed in this article, remain up for future research.

Funding This work is part of the research programme Ethics of Socially Disruptive Technologies, which is funded through the Gravitation programme of the Dutch Ministry of Education, Culture, and Science and the Netherlands Organisation for Scientific Research under Grant number 024.004.031.

Declarations

Conflict of Interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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