On (Un)naturalness

Jan Deckers, Newcastle University, jan.deckers@ncl.ac.uk

ABSTRACT

Many scholars have argued that the distinction between the natural and the unnatural does not have any moral relevance, either because the distinction does not make sense or because, even if it does make sense, it does not make any moral sense. Before we can decide on the latter, we must therefore determine first whether a semantic distinction can be made. In this article, I argue that the distinction can be maintained. In spite of the fact that the categories of the natural and the unnatural are blurred as no unnatural things are completely unnatural, I argue that we can meaningfully distinguish between different types of unnaturalness along the natural-unnatural spectrum. To my knowledge, this article is the first publication to distinguish between three types of unnaturalness.

KEY WORDS

Artifact, ethics, natural, nature, unnatural

INTRODUCTION

In one sense, nature is simply synonymous with everything that exists. Following this premise, nothing is unnatural. However, the concepts of naturalness and unnaturalness are used frequently in various moral debates, for example around the (un)naturalness of genetically modified organisms (GMOs), particular foods, particular human (e.g. sexual) behaviours, and particular medical treatments (Deckers 2005; Van Haperen et al., 2012; Siipi, 2013). Since the concepts of the natural and the unnatural are so widely used, it must be questioned whether there is a sense in which the distinction can be maintained, and if so, whether any such distinction might have moral relevance. Many scholars have argued that it does not make sense to argue that something would be unethical on the basis of its unnaturalness. They have done so either on the basis of the view that it is impossible to distinguish between the natural and the unnatural, or on the basis of the view that any distinction that might be made would not be relevant to ethics. In this article I shall tackle the former view.

DOES THE DISTINCTION BETWEEN THE NATURAL AND THE UNNATURAL HAVE ANY MEANING?

European Union law on GMOs, for example, appears to make a distinction between the natural and the unnatural as GMOs are defined as organisms 'in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination' (European Parliament and the Council of the European Union, 2001: part A, art. 2, par. 2). The natural appears to be contrasted here with processes and 'methods that do not occur naturally' (European Parliament and the Council of the European Union, 2001: annex IA, part 1, pars. 1 and 3), a distinction that – incidentally – many ordinary people make in discussions of GMOs (Wynne, 2001; Deckers, 2005).

In a critical piece on this law, Christiansen et al. (2019: 278) try to make sense of this distinction: whilst recognising that the distinction has been made by several authors, they nevertheless claim that 'on most conceptions, not all GMOs are more unnatural than any non-GMO counterpart'. They also question whether the distinction can be maintained as 'most of the kinds of alterations' represented by GMOs would 'occur naturally', and even speak of 'natural GMOs' (Christiansen et al., 2019: 276, 278).

This is confusing. As philosophers should be trained in the art of making fine distinctions, perhaps we should turn to their work in our quest for clarity. An organisation that produces reports on ethical issues which are partly written by philosophers is the Nuffield Council on Bioethics. In November 2015, it produced an analysis paper on the concept of (un)naturalness, where a working party that comprised several philosophers concluded that the 'unnatural' might be a 'placeholder' for a wide range of moral concerns (Nuffield Council on Bioethics 2015). Whilst this conclusion might be supportable by empirical evidence, it does not address the question whether any semantic distinction between the natural and the unnatural can be made (which might, regardless of any arbitrary connotations, have moral relevance). Whereas the working party does not dismiss the possibility that a meaningful distinction could be made, many other philosophers make short shrift of it. For the purpose of advancing this discussion, I selected an article by Testa and Harris (2005) as it provides a good example of such a dismissal. Testa and Harris (2005: 161) recognise that the distinction is 'so real in people's minds', but proceed by saying that the distinction is 'extraordinarily vague and elusive'. Their view that 'any meaningful distinction between the natural and the artificial … has (been) all but obliterated' is supposed to follow from 'thousands of years of farming practice and selective breeding, including … systematic and widespread cloning of plants, which has proceeded for centuries' (Testa and Harris 2005: 161).

This view is problematic for a number of reasons. Firstly, the authors make their claim in the context of a discussion of gamete-like cells that have been derived from embryonic stem cells which themselves have been derived from embryos created by somatic cell nuclear transfer (cloning). They refer to these as 'synthetic' gametes and distinguish them from 'natural' gametes. Therefore, the sheer fact that they make this distinction – in a more favourable interpretation – questions and – in a less favourable interpretation – contradicts their view that the distinction has been 'all but obliterated'.

Secondly, these scholars use the fact that 'selective breeding' and 'cloning' have been going on for a long time as an argument for undermining the distinction between the natural and the unnatural. They provide the examples of 'roses' and 'tomatoes', writing that many people may not be aware that they 'have probably been cloned' (Testa and Harris 2005: 161). The implicit suggestion in their account appears to be that the natural is that which is not the product of human design. They seem to think that the tomatoes that we eat today, for example, would have been natural if they had been produced by a process of natural selection, rather than by means of breeding methods designed by humans, for example the artificial selection of plants to promote desirable traits. Likewise, the reason they distinguish synthetic from natural gametes relates probably to the idea that only the former might be the products of human design. However, rather than claim that people should reserve the word 'natural' for things that are not the products of human design, Testa and Harris (2005: 161) decide that we should stop making the distinction, precisely because 'many people' do not perceive that many common things which are perceived as natural ('roses', 'tomatoes') have in fact been shaped by human design. The problem with this argument is that the notion that many people are confused about what counts as natural, if true, does not justify the conclusion that the distinction between the natural and the unnatural cannot or ought not to be made.

Thirdly, if Testa and Harris (2005: 161) are right that the distinction between the natural and the unnatural is ‘so real in people’s minds’, it must be regretted that the semantics of this distinction is questioned without an examination of why the distinction is ‘so real’. The reason they wish to jettison the distinction might stem from their reluctance to accept two different meanings of the word ‘nature’. Mill (1904: 7, 8), for example, distinguished between nature as everything that exists in the physical world and nature as that which occurs without being influenced by ‘the voluntary and intentional agency’ of human beings. If the word ‘natural’ is used to refer to everything that exists, we must agree with Testa and Harris that it cannot be distinguished from anything else. Therefore, when a distinction between the natural and the unnatural is made, Mill’s second meaning of the word ‘nature’ may be referred to. Accordingly, we might be inclined to contrast nature with what Mill (1904: 8) referred to as ‘Art’, which stands for human culture: an activity or product would be unnatural if it is influenced by human culture, and natural if it is not. An example provided by Mill (1970: 115) is that of ‘land brought into cultivation’, which he separated from a world ruled by ‘the spontaneous activity of Nature’. On this definition, even some human actions might be conceived of as natural if they are ‘spontaneous’, rather than influenced by human culture. However, as even human beings who are incapable of participating in any cultural activities live in communities that have been shaped by human culture, I shall henceforth assume the presence of culture, rather than of mere instinct or spontaneity, in all human actions.

HAS THE DISTINCTION LOST ITS MEANING IN PRACTICE?

Even if it might be granted that the distinction could be made in theory, the point made by Testa and Harris (2005) could also be interpreted to stem from the view that, since many activities and things are mixtures between natural things and human culture, the distinction may have lost its meaning in practice because of the omnipresence of these mixtures. Consider, for example, the beating of your heart. Whilst this appears to be a natural activity as it occurs instinctively, regardless of your conscious decisions, in reality, the fact that your heart beats is also caused by human culture, for example by your ancestors' decisions to procreate. Similarly, Moriarty (2007: 238) provides the example of cows who have been selectively bred in order to suit human goals, but who were not designed by human culture 'from scratch'. The distinction between the natural and the unnatural, therefore, is blurred. This blurring seems to be sufficient for Testa and Harris (2005) to abandon the distinction. My own view, however, is that this is too hasty. The fact that mixtures between the natural and the unnatural exist need not jeopardise the meaningfulness of these concepts. In response to this challenge, Moriarty (2007: 238) adopts the view that naturalness may apply in varying degrees: 'We may say, for example, that … cows are less natural than bison and more natural than vacuum cleaners.' This would seem to refute the objection. The sheer fact that many activities and things are mixtures of nature and human culture does not eliminate the distinction.

However, this blurring also leaves us with a problem. If the concepts of (un)naturalness can apply to varying degrees in the sense that there would be a spectrum of (un)naturalness, we must determine what criteria can be used to make distinctions. Moriarty does not explain, for example, why, in spite of the fact that the evolution of both has been influenced by human culture, cows would be less natural than bison – by which I assume that he had in mind some American bison who, together with their ancestors, have never been domesticated (for short: ‘wild American bison’). The same problem underlies an earlier version of this paper that I presented at the ‘The Ethics of In-vitro Meat and Enhanced Animals’ conference (18-19 September 2014, Newcastle University). Bovenkerk and Nijland (2017: 404) have remarked rightly that I argued there that the aurochs is more natural compared to a domesticated cow due to the former being ‘completely formed by (her) own goals’. What I did not articulate, however, is that this only applies to aurochs who never experienced any human influence whatsoever, raising the question how aurochs who have been subjected to human influence might differ from conventionally bred cows as far as the naturalness issue is concerned. The same question must be asked in relation to the difference in naturalness that many perceive between conventionally bred cows or bulls, and Herman, the first bull engineered to contain a human gene (Krimpenfort et al., 1991). Whilst the creation of Herman used a different method, biological engineers are increasingly using a more recent technique, known as CRISPR-Cas9, to create such animals. Whilst the process is not fundamentally different in that a gene is replaced by another, the technique has been hailed for being a ‘cost-effective and easy-to-use technology to precisely and efficiently target, edit, modify, regulate, and mark genomic loci of a wide array of cells and organisms’ (Doudna and Charpentier, 2014). If both conventional and new reproductive methods depend on human interventions in natural processes, it must be explored why cows produced by means of genetic engineering or synthetic gametes might either be more or less unnatural than conventionally bred cows.

HOW THE CONCEPT OF TELEOLOGY INFORMS DISCUSSIONS OF NATURALNESS

To shed light on these alleged gradations of unnaturalness, the distinction between internal and external teleology (goal-directedness) must be introduced. A computer, for example, might be said, metaphorically speaking, to be directed to the goal of processing information, but it is not a teleological individual. Whilst this is contested by proponents of strong artificial intelligence (see e.g. Searle, 1980), for this reason I adopt the view that it is inappropriate to hold a computer accountable for immoral behaviour, to take it to court, or to reprimand it. A computer's teleology is an external teleology, as it is not really its own, being determined entirely by the teleologies of the human designers who made it. The internal teleology of an entity refers to its capacity to direct the development of its essence, whereas the notion of external teleology refers to the capacity of another entity to direct it.

Having made this distinction, I must also clarify that the ontology that I adopt has been inspired by Aristotle and, particularly, by Whitehead. The relevance of the former relates to my view that Aristotle (1991) was right to write in '*The Physics*' (book II, 192b) that a good understanding of reality should include understanding some things in terms of their internal impulses, goals, or final causes, and other things, for example beds, as artifacts as they have 'no innate impulse to change', even if it is unclear what he meant and for which entities he held a teleological explanation to be appropriate (see e.g. Cameron, 2010). The relevance of Whitehead (1978) relates to my view that he was right that every real individual ('actual entity') is a teleological entity and that every aggregational society, such as for example a stone, is not such an entity. I also think that he was right that individuals can either be simple or complex. Indeed, Whitehead thought that individuals can be parts either of a greater whole that is an aggregational society or of a greater whole with its own individuality, where Hartshorne (1972) launched the notion of 'compound individual' to refer to the latter. Contra Vogel (2015, 142), a shopping mall is not a compound individual with 'its own developmental processes', 'its own autonomy' (Vogel, 2014, 186), or 'its own "autonomy"' (Vogel, 2015, 142), unless his use of quotation marks here refers here to some different understanding of how 'autonomy' is usually understood. 'Ecosystems' or 'thermostats' are not individuals either (Vogel, 2014, 181-182). Rather, these things are composed of individuals such as atoms and molecules with their own autonomous developmental processes.

In this light, every ontologically real individual, which includes the molecules out of which a computer is made, but not the computer as a whole (as it is an aggregational entity, and therefore only a metaphorically real rather than an ontologically real individual), directs itself in accordance with what Whitehead (1978: 84) calls 'ideals proper to the organism in question', and what might also be called – following Aristotle (1991) – its essence or 'that for the sake of which' (*The Physics*, book II, 198b) something exists. Whilst one organism's essence may resemble that of another, I reject Aristotle's view that the goal that each individual strives towards would be prescribed by the kind, for example the species, that the individual belongs to (where he thought that species were eternally fixed). To be an individual is to be precisely that: to be an individual with one's own essence, distinct from that of others. However, each individual is more closely related to some than to others, a fact that is recognised when we classify things into kinds and species. Each individual's creativity is confined by each individual's unique relatedness to others, as well as by the individual's own past. Not everything is possible. Whilst each individual has the capacity to select its own goals, these goals are confined by the efficient causation exerted by the individual's causal relationships to others as well as to its own past.

Whilst a biological individual's essence is not prescribed by its species membership, its range of teleological options is nevertheless confined by its relationships. Whilst categorising entities into species is marred by the general problem that doing so is to erect discontinuities in the continuous tree of life and by the specific problem that there are 'various causal factors that underlie the patterns of organismal diversity' where 'focusing on different factors ... yields different groupings' (Reydon and Kunz, 2019: 628), understanding an individual's relatedness to others may help us to understand how each individual's developmental options are confined. An acorn, for example, naturally develops into a more mature individual with particular properties that help us to classify it as an oak tree (Aristotle, 1924: 1050a9-17). Its essence or what Lee (1999: 177) calls its 'own … trajectory' is to develop into a mature individual with particular properties that enable us to recognise it as an oak tree, even if we may not know how it is related to its own history and to other organisms. Whereas I reject a static view of nature where individual essences are fixed, the likelihood of an acorn developing into something that is radically different, for example something that we recognise as a birch tree, must be extremely small, if not non-existent.

Nevertheless, some entities can change their essences significantly. As discovered by Griffith (1928), a bacterium that is not virulent – in the example provided by Griffith, Streptococcus pneunomiae – can develop into a bacterium that is virulent by being exposed to the dead remains of virulent bacteria – in Griffith's case: a different strain of Streptococcus pneunomiae. This transformation is caused by the bacterium itself, as it possesses the capacity to alter its essence. The embryo who was modified by human engineers to produce Herman, by contrast, did not possess the capacity to produce Herman. His involvement in the production of Herman did not depend on his autonomous response to particular external factors, but on a change in his essence that was directed by an external teleological agent – in this case: a human engineer. Whereas both the virulent bacterium cultured by Griffith's and Herman are partially artifacts, the latter is more unnatural as only his creation depended on an external, human change in an individual's essence, in this case that of an embryo.

To determine degrees of unnaturalness, it is therefore necessary to distinguish instances where people alter an entity's essence (external teleology) and instances where an entity changes its essence (internal teleology) in response to human action. In the case of the creation of the virulent bacterium that has just been described, Griffith did not alter the bacterium, but merely exposed it to dead material, which prompted it to incorporate foreign DNA so that it became a virulent bacterium. It is, therefore, more natural compared to a bacterium that is created by a process of genetic engineering involving direct human insertion of human DNA into a bacterium, a process that contributed, for example, to the creation of insulin-producing bacteria (Crea et al., 1978; Goeddel et al., 1979; Fineberg et al., 1983).

However, in order to shed light on the full spectrum of unnaturalness, it is important to recognise that entities can respond to human actions in ways that are either rather similar to, or rather different from, how they might have developed counterfactually. The bacterial transformation that was reported by Griffith can also occur without any human experimentation (Conant and Sawyer, 1967). It can therefore be classed as more natural compared to some Streptococcus pneumoniae bacteria that transform themselves after being exposed to an antibiotic in the fluoroquinolone group, which are not known to occur naturally (Claverys et al., 2006; Bisacchi, 2015). This exposure can result in some bacteria developing in ways that are rather different from how they might have developed counterfactually, as they undergo stress-induced mutagenesis (Sierra et al., 2005). Note, however, that such relatively unnatural transformations do not depend on their being exposed to a chemical that is not known to occur naturally. Relatively unnatural changes can also be triggered by people exposing bacteria to unnaturally high concentrations of substances that do occur naturally.

Having recognised the difference between these two types of bacterial transformation, we can now also explore Moriarty's claim that modern day cows are more unnatural compared to wild American bison. Both modern day cows and wild American bison, as well as relatively recent individuals of aurochs, underwent changes because of human beings. Human hunting selected for greater speed, whilst human domestication resulted in selection for greater muscle mass and milk production, amongst other things. Whilst human influence has therefore been embedded within the nature of these animals, the wild animals who live today or have recently become extinct developed in relatively more similar ways to how they might have developed counterfactually under natural conditions. Whilst anthropogenic climate change and hunting practices affected these animals, it is not difficult to imagine counterfactual scenarios where natural climate change and nonhuman hunting would have influenced these animals to develop in similar ways. It is much more difficult to imagine a counterfactual natural scenario where some nonhuman factor would have influenced the ancestors of modern day cows to develop into animals that would be similar to modern day cows. Whilst human selection for traits that predispose for greater muscle mass and milk yield satisfied particular human goals, these traits would impair cows' survival chances in a natural setting. Moriarty is therefore right that modern day cows are more unnatural compared to wild American bison. However, this does not imply that all wild animals will necessarily be more unnatural. Think for example of wild animals who live around Chernobyl, whose bodies have undergone profound changes through exposure to radioactive contaminants that would be unlikely to emerge counterfactually due to nonhuman factors (Mousseau and Møller, 2014), and who may rightfully be seen as more unnatural compared to some populations of farmed reindeer, for example, who may differ little from their wild relatives.

Table 1 illustrates this spectrum of (un)naturalness with the addition of further examples, which will be discussed further anon.

To my knowledge, this is the world's first categorisation of unnaturalness in three distinct types. Note that my theory agrees with the general observation made by Soltanzadeh (2019: 236) that most theories of artifacts only classify something as an artifact if it has been modified by human beings (the modifying condition), but not with what Soltanzadeh understands by the 'intention condition'. Whilst exhaust gases, for example, would not be artifacts for most theories of artifacts if they were unintended by-products of combustion (e.g. Thomasson, 2014), they should still be classed as artifacts in my theory. By reserving the notion of artifacts for things that are 'intentionally created and successfully endowed with certain intended features', Thomasson (2014: 56-57, 45), for example, fails both to recognise artifacts as ontologically distinct entities and to 'provide a better understanding of the significance of artifacts in our lives and in the social sciences'. Whilst her theory may be sound for what I understand to be artifacts in the metaphorical sense, for example vacuum cleaners, she ignores that entities can also be artifacts, at least partly, in a literal sense. Artifacts in the literal sense include those that are unintended, which are factual events that would not have existed without the influence of human intentions.

Contra Vogel (2015: 114), the sheer fact that some artifacts are, just like natural entities, not intended by humanity, is insufficient to justify the conclusion that 'the distinction between the natural and the artificial ... makes no sense'. Whilst people take an interest in knowing which things can be classed as artifacts in the metaphorical sense, they also take an interest in knowing which things can be classed as artifacts in the literal sense, even if there is no such thing as a pure artifact that would be reliant exclusively on human culture for its existence. I think that the widely held perception of GMOs being unnatural (Wynne, 2001), for example, must be understood in large part against the background of public interest in knowing how artificial something is, in a literal sense, or how much it has been influenced by humanity.

In column 4, there is no human influence. In column three, human influence occurs, but entities transform themselves in ways that are similar to what they might have done in counterfactual scenarios where they would not have experienced any human influence. All wild animals who live today, for example, bear the marks of human influence (as human influence is ubiquitous, for example through our role in changing the climate), but many have not been altered as much as conventionally farmed animals (type two), who are likely to have altered themselves more significantly by having been subjected to artificial breeding programmes. In column one, human actions produce new entities directly. As columns two and three consider counterfactual developments (understood here as imaginary developments where there is no human influence), determining whether something fits into one column or the other cannot be decided with certainty. Rather, it depends on considering the probability that a particular entity might have developed in a significantly different or significantly similar fashion by causal routes that did not involve any human influence.

Similar accounts of (un)naturalness have been developed by others. Preston (2008), for example, shares my understanding that genetically engineered organisms are the most unnatural entities if their existence depends directly on humanity, as well as my understanding of what belongs in column four. Holland (2014) appears to recognise types one and two as instances of unnaturalness, but he does not differentiate them. His account is also confusing by identifying the unnatural with that which runs 'counter to one of the prevailing tendencies' of nature (Holland, 2014: 218). In this light, it is unclear why he excludes people with webbed feet and conjoined twins from the category of the unnatural, given that people with such traits are not prevalent. In my account, these people would be unnatural, but – at least prima facie – no more than any other people, where all of us would exemplify instances of unnaturalness. Holland's (2014: 218) claim that 'conventional medical interventions' are not unnatural cannot be maintained either. Some even exemplify type two, for example chemicals that are not known to exist in nature and that, when used medically, cause changes to human cells, for example by causing genetic mutations that make cells divide in ways that are significantly different from how they might have developed counterfactually. An example is cyclophosphamide, a drug used to treat cancer, in spite of its mutagenic effects.

The crucial question, therefore, is not whether or not something exemplifies a prevailing tendency of nature, but whether its essence has been created (type one) or been influenced by human culture in a way that is more (type two) or less (type three) different from its counterfactual development. The difference between Holland's and my account is also clear where we consider another example provided by Holland, the geep. This animal is a chimaera that can be created either by removing the zona pellucida of a developing embryo to coax embryonic cells from a goat and a sheep to combine, or by injecting cells from an embryo of either species through another embryo's zona pellucida (Fehilly et al., 1984). In Holland's (2014: 218) account, the geep is unnatural in that its existence runs 'counter to one of the prevailing tendencies of natural selection, in this case a fairly universal tendency, to gather organisms into groups of sufficiently similar individuals'. On this account, a goat-sheep hybrid, which can occur without any human influence, would also be unnatural, as it is counter to 'a fairly universal tendency' for goats to mate with sheep. On my account, however, such hybrids would be entirely natural.

Whereas I adopt the view that this theory is helpful in discussions of (un)naturalness, I also recognise that it is not free from controversy. Oderberg (2008), for example, has documented rightly that many contemporary philosophers resist thinking of all individuals as teleological agents. The Whiteheadian perspective that I adopt takes a different view. Whereas it supports the view that every individual is influenced by other natural entities, it nevertheless assumes that each drives its own development. For the sake of clarity, I reiterate that this does not imply that all things, whether they be artifacts or natural things, have capacities to direct their own development. Neither a clock nor a stone, for example, has the capacity to direct its own development. Both are aggregates of individuals, rather than ontologically 'real' individuals. Unlike clocks or stones, a Whiteheadian ontology adopts the view that individuals such as atoms, molecules, and living organisms direct their own development. Whitehead (1967: 110) referred to such individuals as either organisms or 'organisms of organisms', where – as I mentioned before – Hartshorne (1972) used the term 'compound individuals' for the latter category. Clocks or stones do not fall into either category as they lack organisational unity. Whereas the question whether things beyond the smallest units of matter are either aggregates or compound individuals is open to debate, I concur with Griffin (1998: 186) that asking 'whether their behaviour seems to require a central agent' may help to settle the matter. A positive answer would result in their being compound individuals.

The alternatives to the view that all individuals – where I presume the existence of a multiplicity of individuals – have capacities to direct their own, purposive developments are not very attractive. The first alternative is that no individuals have such capacities, a view that conflicts with my sense of freedom. The second is that things like atoms, molecules, and living organisms are not really individuals, but components of a cosmic individual, Nature, which directs the behaviour of all its parts. I do not adopt such a Spinozistic perspective as it clashes with my view that all individuals have some independence (Spinoza, 2005). The third is that some individuals have such capacities, but others do not, which raises many questions, including the questions how teleological things co-exist with and how they could emerge from things that lack any power of causation. A dualist who emphasises human separation from the rest of nature, for example, may agree with the common perception that nonhuman natural entities undergo changes, and claim that these are caused entirely by human actions. This view seems implausible to me, at least partly because it clashes with my understanding of evolutionary theory, where human beings arrived rather late on the scene. If this theory is correct, human beings cannot be the causes of all changes in the nonhuman world.

As none of these alternatives appeal to me, an appeal to Ockham's razor is appropriate (Ockham, 1495: i, dist. 27, qu. 2, K). I am, therefore, left with the view that all natural individuals have causal roles in their own developments. They are distinct from unnatural individuals in that only the latter are also under the causal influence of human actions. In reality, however, many things that we are most familiar with are affected by people, which is why few, if any, things on Earth are entirely natural. Events that take place in the Andromeda galaxy, by contrast, are totally natural, at least if it can be safely assumed that they are not influenced by us in any way.

In light of this theory, it is worth highlighting that a number of things that we call artifacts are only relatively unnatural in a metaphorical, rather than in a literal sense of the word. One example is a clock. When human beings make a clock, the components out of which the clock is made may not alter their internal purposes significantly, but they are assembled in such a way that human beings are able to tell the time from them. Qua clock, the clock is an artifact as the internal purposes of the individual entities that compose the clock are in no way directed towards being able to tell the time. The clock's ability to tell the time is derived entirely from a purpose that exists outside of them. By contrast to Herman, this human purpose has not been embedded within the clock itself. A clock made out of gold, for example, may look like a highly artificial thing, but the processes that happen inside the atoms of gold are likely to be very similar regardless of whether or not the gold is used by us. Accordingly, when building a golden clock, human beings imitate what happens naturally when atoms of gold combine to form golden nuggets. As these atoms are not likely to be altered in a fundamentally different way when they are bundled together by us compared to how they might have bundled together naturally, a golden clock is an instance of type three. The materials inside such a clock are less artificial compared to a clock that was made out of molecules that came into existence through human design, for example a clock made out of polystyrene. Such a clock would be an instance of type two not because the clock as such would be any more unnatural than a golden clock, but because, counterfactually, styrene (which occurs in small quantities naturally) is unlikely to develop autonomously into polystyrene (which is unknown to occur naturally), where human causation results in concomitant changes in the material's essence.

For this reason, Moriarty's (2007: 238) claim that a vacuum cleaner is more unnatural compared to a conventionally bred modern cow is problematic. Qua vacuum cleaner, it is an artifact as the individual entities that compose it are in no way directed towards being able to suck up dust. The essence of a modern cow used in the dairy industry, on the other hand, is directed towards producing large quantities of milk. As milk was also produced by the aurochs, the cow might appear to be more natural compared to the vacuum cleaner. However, when we realise that the cow was bred by humans to produce larger quantities of milk compared to the aurochs, we recognise that her essence bears the mark of external design. A vacuum cleaner as a whole, however, does not possess an internal essence. Might it perhaps be that the different components within a vacuum cleaner are more unnatural compared to a modern cow? This would be the case if these components had not been created by external, human stimulation of their micro-components, as for example in the production of plastics from atoms and molecules, but if people had transformed these micro-components directly. As atoms and molecules transform themselves into the (macro)molecules that are used in the production of vacuum cleaners, however, a vacuum cleaner is not more unnatural than a modern cow. Whilst both belong in column two, a modern cow would be more unnatural if the likelihood that a modern cow could have emerged naturally from the aurochs could be plausibly interpreted to be smaller than the probability of the materials inside a particular vacuum cleaner emerging naturally. It is only when we speak metaphorically, ignoring the real individuals that make up a vacuum cleaner, that it is more unnatural than a modern cow, as its purpose is entirely external to the internal purposes of its components.

In a similar way to when they assemble clocks or vacuum cleaners, when human beings set out to create plants or animals with particular features by means of conventional breeding methods, they do not aim to create new entities directly. They are merely selecting between gametes or organisms, deciding which should be given the chance to, respectively, fuse or breed with others. However, the many organisms that have descended from gametes or organisms that have been artificially selected display particular features that are desired by their human designers. The external purpose has become embedded within their essences, resulting in, for example, plants with desirable colours, different dog breeds, cows who are no longer able to give birth, and turkeys who are no longer able to mate. This is why modern, conventionally bred cows are less natural compared to aurochs, as well as to their recent ancestors, who bore the mark of human design to a lesser degree. When people first started domesticating cows and bulls, for example, the animals who were thus created were more similar than modern cows and bulls to the animals who might have existed counterfactually.

In this light, human 'natural reproduction' is also unnatural as it is influenced by human culture, rather than merely by instinctive processes. In in-vitro-fertilisation (IVF) or 'artificial reproduction', as conventionally practised, both gametes and resulting embryos are not intended to be altered by the fact that fertilisation takes place in a different context from the more natural setting. However, significant changes do occur, which may explain why children born through IVF might be more likely to suffer from certain diseases (Källén et al., 2010; Hart and Norman, 2013).

However, regardless of whether or not any undesirable changes occur, the reason it is appropriate to place IVF under the second type relates to the fact that the development of gametes is influenced by the organisms which they are part of, which they are deprived of by being separated. When they are placed in a petri dish, they are altered unavoidably as they are no longer sustained by them, and subjected to different factors of influence, for example greater oxidative stress (Du Plessis et al., 2008). As it is hard to think of any natural events that would be similar to the events that occur in IVF, it is harder to imagine that the human beings born through IVF would conceivably also have been born counterfactually, through natural processes.

These processes contrast with some novel biotechnologies that alter biological entities without reliance on their autonomous capacities, through targeted human interventions within the entities themselves. The gene that was inserted into the embryo to create Herman, the first bull to be genetically engineered with a human gene, resulted in an embryo that directed Herman's development in a different way from the way in which the original embryo would have developed without this intervention. Human intervention resulted in a change in the teleology of the original embryo, who developed into a mature human-bull hybrid with the gene that causes the production of lactoferrin in all his cells. If Herman had never been genetically engineered, but if a different animal ('conventional Herman') had been created by means of a conventional breeding programme, i.e. by means of the artificial selection of organisms or gametes that happened to possess the allele for lactoferrin naturally, he would have exemplified type two. 'Conventional Herman' would be more natural compared to the real Herman as he would have been created by an autonomous process that had merely been influenced externally and selected for by human beings. 'Wild Herman' would differ from 'conventional Herman' as he would possess the alleles for the production of lactoferrin without this having been selected for by human breeders. Whilst 'wild Herman' might resemble 'natural Herman' closely, the former would necessarily be influenced by humanity in light of our entanglement with the natural world. 'Wild Herman' would therefore exemplify type three.

Research has found that many invoke the concept of the 'unnatural' also when they comment on cultured (or in vitro) flesh for human consumption – the production of which has recently been accomplished through stem cell technology (Laestadius and Caldwell, 2015; Jha, 2013). In the theory developed here, cultured flesh is more unnatural compared to conventionally produced flesh, even if both exemplify type two. The reason the former is more unnatural is because the stem cell is deprived of the teleology of the living organism to which it belongs when it is extracted and used to grow other cells that are used for human consumption. This change of context alters its essence, as it no longer fulfils a specific function for the organism as a whole and is no longer influenced by it. Precisely because they are aware that the cell may struggle to thrive outside its more natural context, scientists try to mimic the living environment of stem cells when they engage in this technology, for example by providing them with nutrients. They also do this for any cells that are derived from the extracted stem cells, for example by creating moving scaffolds to imitate muscle movement in the hope that doing so will be suitable for the derived muscle cells. The more that they are able to imitate the more natural context, the more the cells will behave in a similar fashion to how they might have behaved inside living organisms. Their potential to thrive and grow depends on deliberate human stimulation of their natural potential in a different context, rather than on their being stimulated to do so by the teleologies of the organisms whom they were extracted from (as for conventional flesh production). However, cultured flesh is likely to be more natural compared to genetically engineered flesh if scientists avoid introducing direct genetic and concomitant changes in the essence of the flesh. Their aim is merely to coax or trick these cells into doing what they might have done if they had still been inside living organisms (Post, 2012). An example of flesh production through genetic engineering, by contrast, is the production of flesh from the 'AquAdvantage salmon', who was engineered by AquaBounty Technologies (Van Eenennaam and Muir, 2011). This is an Atlantic salmon (*Salmo salar*) who grows much faster compared to wild and conventionally bred salmon through genetic engineering with a gene to stimulate growth from the Chinook salmon (*Oncorhynchus tshawtscha*) and a gene for cold tolerance taken from the ocean pout (*Zoarces americanus*) (Issatt, 2013).

These examples show that an analysis of how an entity alters under human influence, relative to its likely counterfactual natural development, is required to determine its degree of (un)naturalness. It might be asked how we could exclude the possibility of all human influence triggering nonhuman entities to develop themselves in significantly different ways from how they might have developed otherwise. This is a fair point, and it hampers the process of determining whether something can be classed as either type two or type three. The conventionally bred farmed animals who exist today, for example, might have come about counterfactually in a more natural setting where we would not have domesticated any animals. However, this seems extremely unlikely as it is hard to conceive what other factors might have triggered identical changes as those exerted by artificial breeding programmes. Whilst I ignored this possibility earlier on because of its extreme improbability, the same problem besets the distinction between types one and three. It cannot be excluded that the 'AquAdvantage salmon' would come about counterfactually, with human beings being no more than a marginal influence. This would involve some alternative world scenario where genes from the Chinook salmon and from the ocean pout would, somehow, find their way into an Atlantic salmon without human intervention, resulting in a fundamental change in the salmon's essence. However, again, this seems extremely unlikely in light of the fact that it is hard to conceive of (nearly) natural factors that would trigger identical changes as those that followed from the complex procedure that was used to create the 'AquAdvantage salmon'.

PACE OBJECTIONS, THE NATURALNESS-UNNATURALNESS DISTINCTION MAKES SENSE

One objection to this account comes from those who support the view – adopted by the Nuffield Council on Bioethics (1999: 15 and 2003: 23-25) – that genetic engineering would be no more unnatural than conventional breeding as horizontal gene transfer also occurs without human intervention. The Council is right that horizontal gene transfer does occur naturally. It is a frequent event in the bacterial world, but rare in multicellular organisms. Some organisms, mainly bacteria, are also known to have the ability to insert genetic material into plants, but many plants resist such transfers. The objection, however, is flawed, as natural horizontal gene transfer belongs in column four, whereas genetic engineering requires human intentionality. The only question is the degree of unnaturalness involved with genetic engineering, which is determined by whether the design coaxes an entity to develop in a way that is significantly similar to its counterfactual development (type three), is significantly different from its counterfactual development (type two), or alters the entity in question directly (type one). As the concept of genetic 'engineering' draws on the manufacturing process of creating a metaphorically new entity (i.e., literally: an aggregate of actual entities), such as an engine, it may be better to reserve the term only for type one interventions. The aim of the genetic engineering of multicellular organisms is not to either assist or mimic horizontal gene transfer as it occurs naturally, which could, for example, be done by putting organisms that may possess the natural ability to transfer genes horizontally in close proximity to each other, and then wait until genes jump spontaneously from one organism to another. Rather, it involves the extraction of genes that are then inserted directly into other cells, a process that does not imitate nature and that may be highly unlikely to occur either naturally or counterfactually. Genetic material is also moved across species that are not known to possess the intrinsic ability to exchange genes, which is why various methods are used to overcome natural barriers that prevent the incorporation of foreign DNA into cells. Gene guns, bacterial trucks, and electrical or chemical agents are used to facilitate this process, and a promoter gene from a virus is inserted to increase the chance that a foreign gene might be expressed. Gene-like entities that function like genes but are not known to occur in nonhuman nature have even been designed for such transfers. It must therefore be concluded that the view that genetic engineering is no more unnatural than naturally occurring horizontal gene transfer is flawed, even if forms of genetic 'engineering' that depend on the entity's autonomous capacity to change itself, and that might therefore be better called 'modification', for example bacterial transformation, are more natural than others.

A second objection is that genetic engineering would be no more unnatural than conventional breeding as some conventional breeding methods involve processes that do not occur naturally (Nuffield Council on Bioethics, 1999: 21; Halford, 2003: 15, 83). Three common examples are mutation breeding, wide crossing, and traditional plant cloning. Mutation breeding subjects seeds to chemicals or radiation in the hope to trigger beneficial mutations. It differs from the genetic engineering of plants in that it relies on seeds responding favourably by developing useful mutations, rather than on seeds being created directly. The genetic engineering of plants exemplifies type one, where mutation breeding exemplifies type two.

Wide crossing followed by embryo rescue, also called forced crossing, involves breeding between two organisms that are not very closely related, and that produce embryos that are not able to survive without human intervention. The embryo is then rescued or removed from the seed and placed into a nutrient medium that allows it to develop into a seedling, which can then be transferred to the soil. One of the most well-known examples of wide crossing is triticale, a hybrid between rye and wheat, which has been in commercial use, mainly as an animal feed, for over forty years. To overcome the problem of the chromosomes of rye and wheat not pairing, an additional human intervention takes place in the form of chemical treatment. Wide crossing followed by embryo rescue does not imitate a natural process. In their more natural settings, the chromosomes of rye and wheat do not mingle to form a hybrid. It is also misleading to use the word ‘conventional’ to refer to this breeding method as more well-known methods of conventional breeding rely on artificial selection, rather than on the direct creation of entities that is not known to be able to take place simply by means of artificial selection.

Traditional plant cloning would provide a third example of a conventional, but unnatural breeding method. Testa and Harris (2007) provide the examples of cloned roses and tomatoes. Roses have been cloned for centuries, for example by grafting, where stems or buds are cut off from a rose plant and grafted onto a suitable rootstock or stem to produce a plant with branches that are normally genetically identical to the mother plant. Tomatoes can be cloned with great ease, as any tomato grower knows, for example by planting a branch after its removal from the mother plant. Whilst Testa and Harris are right that the human cloning of roses and tomatoes is unnatural, they are wrong to suggest that cloning by somatic cell nuclear transfer is no more unnatural than these methods. The comparison also shows that a teleological explanation is more accurate than an attempt to explain the difference by reference to the question whether some process imitates a natural process. Horticulturalists frequently produce cultivars that are not known to have occurred naturally. They would therefore, in those cases, only imitate nature in a metaphorical sense. A scientist who clones by somatic cell nuclear transfer might also claim that they imitate natural reproduction in the same sense. The crucial difference, however, is that a horticulturalist engaged in traditional cloning merely provides the opportunity for plant parts to alter their essences. Neither a denucleated egg cell nor a somatic cell nucleus, by contrast, are simply provided with the opportunity to reorganise themselves into a clone. They can acquire the potential of a clone, but they cannot do so by fusing autonomously. The cause of fusion, rather, is a human being. This is why cloning by somatic cell nuclear transfer exemplifies type one, whilst plant cloning exemplifies type two or three, depending on how likely the event might occur naturally. The scion (top part of the combined plant) and the rootstock may hybridise to become a new plant with a new genome, but it is more common for both to retain the genome of the parent plant, which is why the scion and the rootstock are usually largely similar to their parent plants. The less likely it is that the entity might have come about naturally, the more appropriate it is to place the entity in column two, and the more likely it is that the entity might have come about naturally, the more appropriate it is to place the entity in column three.

To categorise things accurately, it may be helpful to imagine, merely as a heuristic device, that an entity is situated in column four. A series of questions may then help us to determine whether it should stay there or move into another column. Is it influenced by human beings in any way? If the answer is no, then it stays in four. If the answer is yes, then it moves to three. Has its essence been changed by a human process that is likely to be significantly different from a counterfactual natural process? If the answer is no, then it stays in three. If the answer is yes, then it moves to two. Is this change in essence caused by human action? If the answer is no, then it stays in two. If the answer is yes, then it moves to one.

CONCLUSION

The word 'unnatural' might be better replaced by the less divisive and more neutral 'human cultural' or 'artificial' as none of the above should be taken to suggest that our unnatural practices are anything other than natural. Nonetheless, the word 'unnatural' is used widely by people who do not question that everything is part of nature. Whilst I have not exhausted the meanings that have been associated with the concepts of the natural and the unnatural (Siipi, 2013), I have argued, following Mill (1904), that a semantic distinction can be drawn where the latter pertains to that which is affected by human culture and the former to everything else. More importantly, I have argued, against the position adopted by many others, that the fact that human culture pervades many natural events does not eliminate the distinction, but that it is appropriate to situate the natural and the unnatural at opposite ends of a spectrum. Where an entity should be situated along this spectrum depends on the likelihood with which its essence might have come about counterfactually, which in this case means naturally. This article is, to my knowledge, the first paper that distinguishes between three gradations of unnaturalness, in spite of this continuity.

The reason why the distinction between the natural and the unnatural is – to use Testa's and Harris's (2005: 161) words – 'so real in people's minds', however, does not stem from a neutral observation of a semantic difference between the natural and the unnatural, but from the perception that these different gradations of unnaturalness matter morally, a claim that will be explored in future work.

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Table 1: The spectrum of (un)naturalness, with examples: from more unnatural (left) to more natural (right)

Column one (type one)	Column two (type two)	Column three (type three)	Column four

Human influence, and human alteration of essence	**Human influence, and autonomous alteration that is significantly different from counterfactual natural development**	**Human influence, and autonomous alteration that is significantly similar to counterfactual natural development**	**No human influence**
a genetically engineered bacterium, the creation of which was not directed by the bacterium itself, but by genome editing (e.g. a human insulin-producing bacterium)	a bacterium that transforms itself in response to some human action (e.g. a bacterium of Streptococcus pneumoniae transforming itself after a human being exposed it to an antibiotic in the fluoroquinolone group)	a bacterium that transforms itself in response to some human action (e.g. a bacterium of Streptococcus pneunomiae transforming itself after a human being exposed it to a different strain of the same bacterium)	a bacterium that never experienced any human influence
genetically engineered animals (e.g. Herman)	many conventionally farmed animals (e.g. a hypothetical ‘conventional	many wild animals, living today (e.g. a hypothetical ‘wild Herman’)	an aurochs living before the emergence of Homo

	Herman'); in vitro flesh		sapiens (e.g. a hypothetical 'natural Herman')
a synthetic human gamete, derived from an embryonic stem cell taken from an embryo created by means of somatic cell nuclear transfer (cloning)	a human gamete used in 'artificial reproduction' (in vitro fertilisation, or IVF)	a human gamete used in natural reproduction	a gamete from an ancestor of Homo sapiens