

Does a painless death harm an invertebrate?

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ABSTRACT

This paper explains a meaningful sense in which a painless death can be a misfortune for an invertebrate. The account presented is a logical implication of bringing together two distinct pieces of theory: the deprivation account of the harm of death and the biocentric ethical theory developed by the New Zealand philosopher, Nicholas Agar. Combined, the two theories support the following thesis: death harms an invertebrate because it deprives the individual of future biopreference satisfaction.

Key words: Invertebrates, killing, animal welfare, ethics, conservation, death, euthanasia, environmental ethics, Agar

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Killing invertebrates is an under-explored area in animal welfare and environmental ethics. While some researchers have argued invertebrates are conscious (Elwood and Apel 2009; Merker 2007; Tye 2000; Crook, Hanlon and Walter 2013; Mather 2008; Klein and Barron 2016), have beliefs and desires (Tye 2000; Carruthers 2005), and that the humane treatment principle ought to be extended to invertebrates (Cooper 2011; Crook 2013; see also Fischer 2016), little attention has been paid to the ethics of *painless* killing. Does a painless death harm an invertebrate? An answer to this question will inform an answer to the related question: when, if ever, is it wrong to painlessly kill an invertebrate? If death does not harm an invertebrate, then it is unlikely that it will ever be *directly* wrong to painlessly kill it.¹ Judgements about the harm of death involve drawing conclusions about the psychological life of an animal. The psychological capacities of an animal determine whether it ought to be included within the scope of the moral theories that are ordinarily drawn upon to answer questions about the ethics of killing.² If death does not harm an invertebrate,

then it suggests its psychological life does not warrant that the animal have a place in moral theorizing.

My aim in this paper is to explain a meaningful sense in which death is a misfortune for an invertebrate. The account presented is a logical implication of bringing together two distinct pieces of theory: the deprivation account of the harm of death (Nagel 1979; McMahan 2002: Chapter 2; Palmer 2010: p. 134-137) and the biocentric ethical theory developed by the New Zealand philosopher, Nicholas Agar (2001).³ Combined, the two theories support the following thesis: death harms an invertebrate because it deprives the individual of future biopreference satisfaction. Counter-intuitively, Agar claims that it does not matter whether the organism cares about the satisfaction of the preferences or can conceive of the future in any way. He says:

The teleological approach to preferences reveals the diachronic interconnectedness of an organism's behavioural projects. The lack of an ability to conceive oneself as existing over time does not prevent an organism from having a wide range of behavioural projects that requires its future existence (124).

Because Agar identifies the good for an organism with the pursuit of environment-directed goals – ‘biopreferences’ — (2001: p. 94), death will be bad for that organism because it forecloses the chance to achieve these goals. As we will see

1 Note: it may still be indirectly wrong to kill invertebrates even if they are not harmed by death. A range of indirect considerations may count against killing invertebrates: killing invertebrates may have detrimental environmental consequences for an ecosystem that is highly valued; killing an invertebrate may reflect poorly on a person's character – it could be construed as wasteful or indicative of human chauvinism; killing invertebrates may be wrong for religious reasons such as violating a Buddhist or Christian ideal of non-violence.

2 The view that an animal, human or nonhuman, qualifies for inclusion within the scope of ethical theorizing in virtue of possessing a requisite degree of psychological capacity is known as ‘moral individualism’ or ‘the psychological theory of intrinsic value’. A view of this kind is a basic presupposition of animal welfare theory and practice. The intuitive rationale for privileging psychology is that without it, a thing is just a thing and it cannot be harmed in morally relevant ways. Carruthers (2005, p. 178, n.1) draws a potentially helpful distinction between biological harm and psychological harm. He claims that while it is meaningful to say that all living things, including plants, can be biologically harmed; only sentient animals can be psychologically harmed. Agar's

project is an attempt to extend a time-honoured notion of harm (preference frustration) beyond sentient animals to all living organisms.

3 My purposes are more logical than ethical, that is, I'm simply aiming to show that there is a sense in which death can be bad for an invertebrate. I'm interested in giving scientists pause for thought and a theoretical grounding for the concern many feel about the ethics of killing invertebrates in the course of research. Of course, the soundness of the analysis to follow turns on the soundness of the deprivation theory and Agar's theory. Constraints of space prevent me from offering a thorough defence of each position and readers should understand my analysis as drawing attention to a hypothetical or conditional implication of accepting each position.

below, for Agar what matters is not whether the organisms are sentient and feel pleasure or pain, but whether their biological goals can be specified in a scientifically credible way to be plausible analogues for the preferences or desires of *Homo sapiens* and other mammals.

The harm of death

When philosophers examine the harm of death they are focused on the harm it is (or may be) for the individual that dies. No one seriously questions that death harms the relatives and friends of the deceased. Obviously, grief is an unpleasant experience and is enormously disruptive to an individual's life. A person grieving the loss of a loved one is clearly experiencing unpleasant emotions and we can unproblematically say that they are worse off, all things being equal, than they were prior to the death of their loved one.

Philosophers are also not concerned with the pain and suffering experienced by an individual who is in the process of dying. No-one in their right mind would question that dying a slow and painful death from injuries or disease constitutes harm to the individual concerned. As with the person who is grieving, a dying person experiences pain and anguish and is clearly worse off than they were prior to their injury or illness. The issue that philosophers are concerned with is perhaps best understood as seeking answers to a question such as, 'If you were to die painlessly in your sleep tonight, in what sense can we say that you have been harmed by death' (Nagel 1979)? This question is intuitively puzzling. After all, at the time of your death you will experience no unpleasant sensations, and when you are dead, you are not around to experience any misfortune. Does it even make sense to suggest that you are worse-off? Unlike the terminally ill or grieving person, when you are dead you are not around to experience unpleasant sensations or to have your desires frustrated. It seems, then, that there can be no basis of comparison between your life post-death and your life prior to death. How, then, can it be said that you have been harmed by death?

With the exception of the ancient philosopher, Epicurus, who believed that you could only be harmed by experiencing an aversive sensation of some kind, most philosophers accept that individuals *can* be harmed by a painless death.⁴ When your lawyer embezzles the money you left to your child in your will, this harms *you* not just your child. Likewise, you are harmed when your friends bad mouth you behind your back. Posthumous harms are viewed as similar to harms that befall you that you don't know about (Nagel 1979, p. 4). Both of these judgments are explained by your desires. You desired to leave the

⁴ Among the class of philosophers that reject the Epicurean view, while some hold that only self-conscious individuals with forward looking mental states can be harmed by death, others accept it is sufficient that the individuals simply have mental states at some time in the future, irrespective of whether they are able to reflect upon these mental states or not.

money to your child, and you desire to be liked by your friends. Desires are the key to understanding the concept of posthumous harm—and, as will become clear below, they are also important for understanding the sense in which invertebrates can be harmed by death.

The deprivation theory of the harm of death

Given the assumption that an individual can be harmed by death, the orthodox position is that death is a harm for the individual that dies if their future was likely to include certain 'goods'. Think of people with terminal illnesses in voluntary euthanasia cases, or the ending of life-support in cases of brain death. While death in such circumstances may be tragic for relatives and friends, it is not harmful to the person who dies because their future was lacking in the goods that make life worth living.⁵ Cases like these point to a connection between the goods of life and the harm of death. In line with a theory of the harm of death known as the deprivation theory, death is a bad thing because it robs the individual of the chance to enjoy the goods that life has to offer (Luper 2014; Nagel 1979, Chapter 1; DeGrazia 1996: p. 231-234).

Not surprisingly, there is widespread debate amongst philosophers over which goods are the relevant goods. Debate about 'goods' usually takes place in the vocabulary of welfare or well-being. Philosophers known as hedonists measure well-being with reference to pleasure (Bramble 2013; Crisp 2006). For hedonists, death is a harm because it deprives the individual of future pleasures. Desire theorists measure well-being with reference to desire satisfaction (Heathwood 2006; Mill, 1996). For desire theorists, death is a harm because it deprives the individual of the satisfaction of future desires. Other philosophers say that certain goods are valuable irrespective of whether they are pleasurable or desired (Griffin 1986; Finnis 2011). In line with the so-called 'objective list' theory of well-being, death is bad because it deprives you of goods like relationships, achievements, knowledge, creative pursuits or, in the case of nonhuman animals, a species-typical life (Nussbaum 2004).

However the goods of life are understood, the consensus view is that individuals likely to lead long lives with foreseeably high levels of well-being are harmed more by death than individuals likely to lead short lives of low quality. The reasoning is simple: individuals likely to live well the longest lose more when they die, so death harms them more; individuals likely to live a short life of low quality lose less, so death harms them less. Bear in mind that this is a comparative claim. It neither entails that it is good to die, nor that some people deserve to die. It is just to say that the harm of death varies based on the foreseeable quality and quantity of the future life.

⁵ In the terminal illness case the person is clearly harmed by the illness, and in the life support case the person is harmed by the brain injury; neither is harmed, however, by death itself.

Agar's biocentrism

With the development of his biocentric ethical theory, Nicholas Agar (2001) has put us in a position to say that death is bad for an invertebrate because it robs the individual of the enjoyment of future goods. Consistent with the desire theory of well-being, for Agar the relevant goods are the satisfaction of evolutionarily-endowed 'biopreferences' (2001: Chapter 6). 'Biopreferences' is the term Agar uses to refer to the evolutionarily-endowed environment-directed teleological ('goal-seeking') behaviour of all living organisms. As an environmental ethicist, Agar's aim is to provide an analysis of life that is morally compelling enough to prompt people to think about individual nonsentient organisms as worthy of ethical consideration in their own right. His strategy is, firstly, to define what it means to be alive as having the capacity for self-movement and then, secondly, to analyse self-movement as a biofunctional analogue of a concept that is well-established as a marker of moral significance, desire. Explicating evolution-directed self-movement in terms of acting in accordance with a 'folk psychological' ⁶ inner states means that Agar's theory meshes logically with the central tenet of animal welfare: the psychological theory of intrinsic value.

From self-movement to desire

For Agar, then, to be alive is to have the capacity to move oneself in response to changes in one's environment. Agar says that this capacity is made possible by living things having two features – he calls them 'devices' (2001: p. 91): a device for detecting environmental change, and a device for initiating movement. Borrowing a specialised term from the philosophy of mind, he says it is meaningful to call the conceptual 'link' between the two devices a 'representation'.⁷ Accordingly, when a living thing detects change and responds, Agar interprets this as the individual acting to satisfy an evolutionarily endowed biofunctional preference or, as he puts it, undertaking representationally guided movement:

Organisms would have acquired the ability to produce movements, not just randomly or all the time, but in response to fairly specific environmental prompts. We can call the structure linking the sensor of the ecologically salient environmental property, to the movement producer, a representation. A representation is a device that contains information about the environment. Biofunctional explanation will type representations in terms of what they are supposed to do. A representation is a structure

⁶ 'Folk psychology' refers to common sense or everyday theory of mind – the intuitive concepts and principles, specifically, beliefs and desires, that people employ to make sense of the behaviour and mental experiences of other human beings and, perhaps, other mammals (Churchland 1995).

⁷ 'Representation' is a term used to refer to what the inner state purportedly represents to the organism. In line with folk psychology, beliefs and desires represent features of the world. True beliefs represent the world accurately, false beliefs misrepresent the world. Desires represent a way the world ought to be from the perspective of the desiring creature.

whose biofunction is to appropriately modify or funnel the impact of environmental forces through to movement or change. Such movement will be in response to the environmental property whose name figures in the content of the representation. No great biological sophistication is required (Agar 2001: p. 91).

Agar draws upon evolutionary biology to specify the content of an organism's suite of representations. The content of a mental state is the 'what-it-is-about'-ness. A teleological theory like Agar's specifies content with reference to the evolutionarily-endowed functional ends or goals of the living thing (Millikan 1986; Papineau 1993). The goal of the T4 virus, for example, is to replicate, more specifically, it is to attach itself to bacteria and inject a fluid. Agar says we can build an account of the content of T4 virus representations from these basic facts. He specifies the content as: 'injection of material into bacterium', 'lodgement of DNA into sugary coated thing' and 'replication of genes' (Agar 2001, p. 102). The content of the biopreferences of ticks can likewise be explained in this way (Carruthers 2005, p. 224): 'Butyric acid vapor', 'release grip on perch', 'burrow into warm-bodied host'. Agar describes his teleological analyses of goal-directedness as 'plausible naturalisations' (2001: p. 94, p.102) and 'customised descendants' (2001: p. 96) of folk psychological beliefs and desires.

Agar then arrays all living things on a continuum from the simplest organisms, such as the T4 virus, to the most complex, such as the great apes and human beings. While a simple organism like the T4 virus has just one representation, complex organisms like human beings will have many. The more representationally complex an animal is, the more morally significant they begin to appear under the ethical auspices established by the central tenet of animal welfare theory: moral individualism or the psychological theory of intrinsic value. As Agar says: "As organisms have more varied and numerous goals, they tend to become more folk psychological. Folk psychological notions, in turn, have closet association with the relevant normative notions." (2001: p. 100) In other words, the more an animal can detect and respond to change in the environment, the more its behavior can be meaningfully interpreted as acting to satisfy the kind of desires that are ordinarily regarded as having a bearing on judgments about the harm of death.

Practical application of biofunctional preference satisfaction deprivation account of the harm of invertebrate death

Applying the biofunctional preference satisfaction deprivation account outlined above, researchers must, firstly, estimate the representational complexity of the individual to be killed. In effect, this requires the researcher

to ask: in how many different ways can this creature detect change in its environment and respond to change? An answer to this question will put the researcher in a position to gauge the value of the organism's life using preference satisfaction as the measure of value. Secondly, all proponents of the deprivation theory allow for longevity to play a role in determining the relative harm of death: individuals that are likely to lead long lives with high levels of well-being will be harmed more by death than individuals that lead shorter lives of low well-being. Accordingly, researchers must estimate how long the individual to be killed was likely to live. This will no doubt be a difficult task but, presumably, researchers will be able to draw upon existing species life-cycle data, and they will also need to factor in any environmental and anthropogenic threats, such as land clearing, bushfires, pesticide spraying, drought, etc., facing the target population.

Case study: *Petalura gigantea*

Imagine that a researcher is investigating the ecology of *Petalura gigantea* (Giant Dragonfly) in the Blue Mountains, west of Sydney. Say that the researcher needs to kill a specimen and wants an estimate of the extent to which death will be a misfortune for the animal. The deprivation theory of the harm of death requires that we compare the value of the life of the organism at the time that it died with the overall value of its life had it not died when it did. Utilizing Agar's theory to gauge the harm of death, we must use biopreference satisfaction (and frustration) as the measure of value. Let's stipulate that the organism is to be killed one month into the final stage of its lifecycle as an adult dragonfly, which ordinarily extends to four months over summer and early autumn (Baird 2012: p. 32). First, a value must be fixed for the organism's life up until the time it died.⁸ For ease of exposition, let's stipulate that this organism was lucky and the value of its life up to the time it is to die is overall positive (+50).⁹ Were the organism not to be killed, it would live for another three months and, again, for ease of exposition let's assign a value of +50 for each month. So, the lifetime value of the organism's life is $4 \times 50 = 200$. To calculate the harm of death for this organism we deduct the expected lifetime value of the organism's life from the value of its actual life: 50 minus 200 and this gives us a value of -150. This value is the extent of harm to the organism dying at one month of age.

8 Assigning the value (and disvalue) to the satisfaction (or frustration) of each biopreference could vary: each preference could be assigned the same weight, or some preferences could be valued more highly than others. This example is based upon the calculation procedure given by Luper (2014).

9 Drawing upon population biology and Bayesian epistemology, and using the prevalence of suffering as a yardstick, Horta (2010) claims that the lives of most wild animals are disvaluable. If Horta's kind of analysis could be extended to invertebrates, and if biopreference satisfaction or frustration was used as the measure of value, then death would not be a harm for most wild animals. Horta's claim is controversial and constraints of space prevent a thorough examination of it here; suffice to say that, even if true, such an analysis does not call into question the coherence of using biopreferences to extend the deprivation theory to invertebrates in the first instance.

Generally speaking, it is safe to say that other individuals from the target population who died later in life will be harmed less by death. If researchers happen to study specific individuals, the value assigned to the organism's lifetime welfare level, and the value of the welfare level of the organism's actual life can vary in response to specific events and contextual factors; otherwise, assigning values at the level of population groups, and using normal species lifespan as a guide to longevity, will have to suffice. Like any form of decision-making based upon foreseeable consequences, researchers acting in good faith will have to make an educated guess, drawing upon available information and their own experience and expertise.

Objections and replies

The biopreference satisfaction deprivation account of the harm of invertebrate deaths faces a number of objections. It might be objected that the preferences of invertebrates are disanalogous to the preferences or desires of mammals because they lack an experiential dimension. Another way of making this objection is to claim that a creature can only be harmed by deprivation if there is a meaningful sense in which they care about losing the goods concerned. The objection continues; because invertebrates are not sentient or phenomenologically conscious there is no meaningful sense in which they care about missing out on biopreference satisfaction. But while it is most likely true that if invertebrates are not conscious they do not care about their biopreferences in a first-person sense, this does not mean there is no grounds for thinking that biopreference satisfaction deprivation deserves a place in ethical thinking. There is a meaningful sense in which invertebrates objectively benefit from having their preferences satisfied irrespective of whether they care or not, say, by obtaining life-sustaining nutrition or evading predators. This may not be as compelling a consideration as subjectively caring about deprivation but it is sufficient to keep invertebrates within the remit of the deprivation theory.

A related objection concerns the ethical significance of preferences. In line with the objection, the ethical significance of preferences is either a function of the feelings associated with preference frustration or satisfaction, or the autonomy behind the decision to act upon the preference. Accordingly, the biopreferences of invertebrates are not ethically significant because they neither have an experiential dimension nor are the product of autonomous choice. But, again, the consciousness of invertebrates is a matter of active controversy. If it turns out that invertebrates are sentient there may well be an experiential dimension to the satisfaction or frustration of biopreferences. The objection will be sustained, however, when the behaviour of invertebrates is determinately rigid. While preference autonomy need not require that the animal be able to reflect upon their preferences in a second-order sense, some degree of mental flexibility is required. A flexibility condition would restrict the reach of the ethical

significance of biopreferences and, thereby, also restrict the scope of the biopreference deprivation account of the harm of death to species such as cephalopods (Mather 2008), honeybees (Gould and Gould 1988) and jumping spiders (Tarsitano and Jackson 1994).

A third objection is anthropomorphism. Does the above analysis mistakenly attribute to invertebrates traits or capacities that are exclusively human? Recall that Agar's theory is founded on an analysis of life in terms of self-movement. He firstly turns to evolution to explain the origins of self-movement and, then, in attempting to say more about what self-movement involves, he draws once again upon evolution to describe self-movement as the pursuit of environment-directed teleological goals. Presumably, it is not anthropomorphic to suggest that invertebrates can move themselves. The controversial move in his analysis is his usage of the term 'goal' – it connotes reflective choice or purposiveness. But, when close attention is paid to the language of the evolutionary biology side of Agar's analysis, his choice of words is uncontroversial. For example, when he explains that evolution has furnished a fly-eating frog with the 'representational machinery' (2001: p. 105) to catch flies, he suggests that fly-catching behaviour can be understood in terms of the 'statistically normal angle of flight and velocity of historical flies' and the 'statistically normal backgrounds of the visual systems of historically normal frogs' (2001: pp. 105-106). If the language of the evolutionary biology part of Agar's analysis is not belabored with discrediting anthropomorphism, it is difficult to see how the ethical theory part could be. It's just a fact that if an organism is killed it will not get a chance to engage in environment-directed behaviour. Bear in mind that the meaningful extension of the deprivation theory to all living organisms does not require that the achievement of biofunctional goals matters to the organism itself in some first-person reflective sense.

A final objection concerns the scope of the biofunctional preference deprivation account of the harm of death. If, as has been suggested, death harms an invertebrate because it deprives the individual of future biofunctional preference satisfaction, then death will be a misfortune for any organism that has evolutionarily-endowed biofunctional goals. The objection continues, as the account above drew upon Agar's biocentric ethical theory, and given also that the scope of Agar's theory extends to all self-moving organisms, then an implication is that death is a misfortune for zygotes, asthma weed, and bacteria—and this is absurd. But bear in mind two points: (1) while Agar's theory opens the logical door for the possible extension of the deprivation theory to plants, the intrinsic moral significance of plant death turns upon to the extent to which plant biopreferences are plausible analogues for the folk psychological mental states of *Homo sapiens*. It may be that the line between insects and plants marks the boundary of the analogy; in which case the objection misses the mark; (2) a theory of the *ethics of killing* need not be read exclusively off a theory of the *harm of death*. While an analysis of the harm of

death points to the psychological life of the creature, it is not all there is to say about the normative significance of psychological life.¹⁰ A key question that the biopreference satisfaction deprivation account of the harm of death does not address is whether the degree of psychological complexity of the creature is sufficient to warrant inclusion within the scope of the over-arching ethical theories that are used to determine the permissibility of killing: rights or deontological theory, utilitarianism, and virtue theory.¹¹ In the next section I will briefly address the implications of the biofunctional preference deprivation theory for each theory.

The harm of death and the ethics of killing

The first leading ethical theory is rights or deontological theory (Regan 1983; Taylor 1986). In line with rights theory, rights function like protective shields around their bearer, effectively ring-fencing them from being harmed by others. As far as invertebrates are concerned, the key question is whether their representational complexity points to the kind of psychology that warrants the attribution of rights. Ordinarily, the grounds for *moral* rights, as opposed to legal rights enshrined in legislation, is some psychological capacity of the individual, such as sentience or rational autonomy. Assuming that they have a psychology at all, there is no logical obstacle standing in the way of extending rights to invertebrates; it all depends on the inclusiveness of the particular rights framework used by the researcher. If invertebrates are owed rights, then it's a question of strength: will the animals have rights that are so strong that they ought to never be overridden, or will the rights be such that, in certain circumstances, the gains of research are sufficiently important to override them? This question points to an important distinction between moderate and absolute rights theories (Kagan 1998: Chapter 3). In line with moderate rights theories, rights may be overridden only when the consequences of doing so are overwhelmingly good; in line with absolutist rights theories rights must never be overridden and it is wrong to violate rights, period. As bearers of moderate rights not to be killed, it will be permissible to kill invertebrates only if the benefits of the research are sufficiently good to justify violating their rights. As bearers of absolute rights, only non-invasive non-lethal research involving invertebrates would be permissible.

¹⁰ Tom Regan (1983), for example, argues that what is important about psychology is that its bearer has a particular kind of value he calls 'inherent value'. Regan claims that among the class of all creatures with the suite of psychological capacities that he holds as grounds for moral rights, inherent value is restricted to 'normal mammals of one year or more'.

¹¹ In addition to deontological theory, utilitarianism, and virtue theory, contractarian theory and care ethics could also be used to determine the permissibility of killing. The inclusion of invertebrates within each framework turns upon, respectively, whether invertebrates can be parties to, or beneficiaries of, the social contract, and whether relations between humans and invertebrates are of the kind to engender moral sentiments and attendant duties. For an informative recent discussion of each theory see Garner (2013). For their part, Taylor (1986) and Varner (1998) each offer principles for addressing the ethics of killing in cases when the interests of different individuals conflict.

Utilitarians do not conceive of ethics as a set of moral entitlements that function like shields to protect beneficiaries from harm; instead, ethics is a collective enterprise in which all participants have a responsibility to promote the utilitarian goal throughout the course of their lives. The aim of utilitarianism is to promote the greatest good for the greatest number, where 'good' is understood in terms of preference satisfaction (Singer 1993). The aim of any decision is to maximise the net aggregate balance of preference satisfaction over preference frustration. As far as invertebrates are concerned, the key question is whether their preferences are of the kind to be factored into a utility calculus aiming to promote the utilitarian goal.¹² Researchers must ask themselves: is this protocol or specific procedure likely to be casually efficacious in promoting the greatest good? Killing invertebrates will be wrong if it fails to bring about the utilitarian goal and right if it secures the utilitarian goal. Similar to rights theory, there is no logical obstacle standing in the way of extending utilitarianism to invertebrates. Once their preferences are included, however, the permissibility of killing will need to be determined on a case by case basis.

The final ethical theory that researchers may employ to determine the ethics of killing is virtue theory (Aristotle 1999; Hursthouse 2000). Whereas rights theory and utilitarian theory are rule-based approaches, the focus of virtue theory is the character traits or 'virtues' of persons. In line with virtue theory, researchers must be skilled practitioners in their field but also magnanimous, truthful, friendly, courageous, and humble. In many respects, virtue theory is the most demanding ethical theory because the acquisition of virtue requires years of practice under the good counsel of mentoring elders. The ideal of virtue theory is an emotionally intelligent person for whom acting ethically comes naturally after years of habituation into a virtue-enhancing milieu. The key question is whether the biopreferences of invertebrates

¹² Some utilitarians, for example, Peter Singer, may insist that to be included in the utility calculus, invertebrates must be sentient because then the satisfaction, or frustration, of their biopreferences will be accompanied by a positive or negative sensation that is the ultimate basis of the moral significance of preferences. Logically, however, the inclusion of biopreferences into a utility calculation does not require sentience, and the satisfaction or frustration of the biopreference can be a matter of ethical significance in its own right. See the discussion in Carruthers (2005, Chapters 9 and 10).

are the kind of variable that needs to be taken into account when judgements are made about the character of the researchers who kill them. Does having the virtue of kindness, for example, require that researchers extend their kindness-sensitive behaviour to the invertebrates in their care? Does a researcher that unreflectively kills an invertebrate betray a character vice such as hard-headedness? Answers to these questions, like the questions concerning the scope of rights theory and utilitarianism mentioned above, turn upon the importance placed upon the lives of invertebrates by individuals and society at large. If people value the lives of invertebrates enough, then animal welfare norms and codes of practice will enjoin researchers to apply the invertebrate-inclusive version of the relevant ethical theory.

Conclusion

In the above I presented a framework that affords a positive answer to the question: does a painless death harm an invertebrate? The positive answer was a logical implication of combining two theories: the deprivation theory of the harm of death and Agar's biocentric ethical theory. The deprivation theory holds that death is a harm because it robs the individual of the opportunity to enjoy the goods of life. Agar identifies the goods of life with the satisfaction of evolutionarily-endowed environment-directed biofunctional goals ('biopreferences'). Accordingly, death harms an invertebrate because it robs it of the opportunity for future biopreference satisfaction. The harm of death will vary depending upon the value of the individual life lost, and value will be a function of the opportunities for biopreference satisfaction, taking into account longevity. Roughly, individuals that live well the longest will be harmed more by death than individuals that live short lives of low value. Judgements about the harm of death point to the psychological life of the organism. The level of psychological sophistication will determine whether the organism features in the leading ethical theories that are used to determine the ethics of killing. All of the leading theories can be adjusted to accommodate the biopreferences of invertebrates. Whether invertebrates *should* be included with the scope of the main ethical theories was not an issue explored in this paper.

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