Environmental Politics
Vol. 00, No. 0, Month 2012, 1–17

Routledge
Taylor & Francis Group

Climate ethics: with a little help from moral cognitive neuroscience

Marco Grasso*

Department of Sociology and Social Research, Università degli Studi di Milano-Bicocca, Italy

Carbon emissions threaten the stability of climate systems and change climate dynamics in ways that inflict harm on present and future generations. Therefore, the ultimate moral crux of climate change involves harm avoidance and prevention. Moral cognitive neuroscience, and in particular the dual-process theory, indicates that up, close and personal harm triggers deontological moral reasoning, whereas harm originating from impersonal moral violations, like those produced by climate impacts, prompts consequentialist moral reasoning. Accordingly, climate ethics should be based on consequentialist approaches. Moral cognitive neuroscientific research indicates, in fact, that consequentialism is closer to the moral processes and judgements human beings normally use when faced with issues like climate change that involve impersonal notions of harm.

Keywords: climate change; climate ethics; consequentialism; deontology; dual-process theory; moral cognitive neuroscience

Introduction

Al Gore (2007), who was awarded the 2007 Nobel Peace Prize jointly with the Intergovernmental Panel on Climate Change (IPCC) for their efforts against climate change, claims that: '[t]his [i.e. climate change] is not a political issue. This is a moral issue, one that affects the survival of human civilization'. Similarly, James Hansen (2010), NASA's leading climatologist, writes: '[t]he predominant moral issue of the 21st century, almost surely, will be climate change, comparable to Nazism faced by Churchill in the 20th century and slavery faced by Lincoln in the 19th century'. Climate change, in fact, is 'fundamentally an ethical issue' (Gardiner 2004, p. 556), one that, challenging our established morality, threatens our lives and our world (Gardiner 2004, Jamieson 2008).

*Email: marco.grasso@unimib.it

ISSN 0964-4016 print/ISSN 1743-8934 online

http://dx.doi.org/10.1080/09644016.2012.730263
http://www.tandfonline.com

Consistent with the scientific consensus, I assume that climate change, despite denialism, *exists* and that there is '*very high confidence*' (IPCC 2007a, p. 3, emphasis in the original) that human actions have an impact on climate systems. In particular, climate change is causing an array of negative impacts on our planet's natural and socio-economic systems (IPCC 2007b), which are directly or indirectly harmful to all mankind and potentially catastrophic for many of the poorest people in the world. The most prominent of these human-threatening impacts, which are regionally differentiated, include increased water stress and reduced crop yields; rising sea levels; increased inland floods and coastal flooding and erosion; reductions in the thickness and extent of glaciers, ice sheets and sea ice; exposure to new health risks; rises in the frequency and severity of extreme climatic events; and increased conflicts over the control of scarcer resources, migrations, state failures and the resulting risks.

Given the ultimately harmful nature of climate change to mankind and consistently with the only fundamental requirement shared by all the different accounts of morality, avoidance and prevention of harm to some others (Gert 2011), I argue that the moral foundation of climate change relates to avoiding/preventing harm, as the objective of the United Nations Framework Convention on Climate Change (UNFCCC) – that is, prevention of dangerous climate change (art. 2) – implicitly acknowledges, and critically depends on actions people take now that harm and will harm other people living now and in the future. I uphold here the traditional Lockean view, according to which harm relates to the endangerment of anyone's life, health, liberty or possessions. In this context of analysis endangerment originates from the impacts of climate change specified above and can be personal and impersonal, as made clear in what follows. In particular, anthropogenic carbon emissions (i.e. the harmful actions related to the use of fossil fuels, long-term deforestation and agricultural practices) by a diverse group of people around the globe, which by consuming a common resource such as the atmospheric absorptive capacity, threaten the stability of climate systems and consequently alter climatic dynamics, harm a diverse group of present and future people even in remote parts of the globe. In the same vein, Shue (2011) considers the requirement to do no harm as the fundamental component of climate ethics, although, as pointed out in the ensuing section, he addresses climate harm on different grounds than I do. Also Vanderheiden (2011) maintains that any plausible theory of justice should uphold a strong imperative to prevent people from suffering climate-related harm. It is also worth noting that this notion of harm is akin to that of injustice, i.e. something wrong that exists *per se*, independently from, and prior to, considerations of justice (Wolgast 1987), as specified later.

The scant familiarity with, and knowledge of, climate change determined by mental models and ontological assumptions (Chen 2011), cognitive biases and use of heuristics (Baron 2006), and misunderstandings of risk and harm's physical traits (Sunstein 2006), make its political, socio-economic, and moral

aspects particularly challenging and contentious. In fact, the increasingly sophisticated current literature on the moral implications of the climate crisis by and large does not consider harm as the central moral tenet and prefers to apply a resource-sharing perspective centred on the allocation of costs and benefits of actions related to climate change (Kamminga 2008), independently form any consideration on harm.[1] This dominant perspective argues that climate change entails two moral commitments: first, to curb anthropogenic greenhouse gases (GHG) emissions and/or enhance their sinks in order to avert dangerous interference with the climate system; and second, to support and fund efforts aimed at preventing climate change or adapting to its impacts. These moral commitments are called the *duty of mitigation* and the *duty of adaptation*, respectively (Caney 2010), and they both are subject to intense debate in the burgeoning relevant literature. The two duties involve different areas of ethical inquiry: scientific uncertainty, responsibility for past emissions, the setting of mitigation targets, adaptation and compensation for past and future harms, scientific and technical resources, geo-engineering and threats to non-humans (Gardiner 2010, Jamieson 2010). In light of the dichotomy of the duties emphasised, a large and rapidly growing body of literature, impossible fully to review here due to space constraints, investigates these areas.[2]

However, in my view, both the duty of mitigation and the duty of adaptation are instrumental. In other words, they are means for dealing comprehensively with the harm resulting from climate impacts, the ultimate end of the struggle against climate change. In fact, the only way to avoid/prevent harm associated with climate change requires both protecting nature form society (mitigation, i.e. avoidance of harm) and society from nature (adaptation, i.e. prevention of harm) (Stehr and von Storch 2005). It is necessary to point out that here I refer only to the orthodox entry points for mitigating climate change, based on the usual actions for reducing carbon emissions, from cutbacks to sequestration. Therefore, I do not consider geoengineering techniques because of their totally different ethical implications (Gardiner 2011).

In particular, both harm avoidance and long-term harm prevention depend almost exclusively on mitigation efforts, whereas short-term harm prevention largely depends on adaptation measures. Consequently, I argue that the mitigation and adaptation moral commitments are two sides of the same moral coin because they both ultimately address, generally from a resource-sharing perspective, a single, fundamental moral issue, namely, avoiding/preventing some people from harming other people, the moral core of climate change. Thus, harm is ultimately the source of moral dilemmas, that is, moral questions for which there are multiple answers inspired by different moral principles and/or theories, arising from climate change. Moreover, I argue that harm resulting from climate change originates from relatively impersonal moral violations (as I show in the following section) and that its inherent intertemporal/transgenarational character (Schuppert 2011, Shue 2011) further emphasises this impersonality, as also stressed by evolutionary psychology (Gilbert 2006).

Therefore, if climate ethics is to be as close to human morality as possible, its guiding principle should be the acknowledgment of the harm-related moral nature of climate change and of the impersonality of this harm. To substantiate this moral centrality of harm, a reference to the notion of injustice introduced above is in order. The scientific evidence makes it clear that climate-related harm would be to a large extent avoidable if more attentive behaviours and policies were adopted. Therefore, in the language of injustice, the climate crisis involves human blameworthiness, and people harmed by climate change are to be considered also victims of injustice (Shklar 1990). According to this perspective, it is first necessary to deal with the dynamics of injustice because it has a priority over justice that requires initially concentrating on what is wrong, in this case harm – as, in fact, the current harm-related approach to climate ethics demands – and only afterwards concentrating on what is right (Simon 1995), in this case the just allocation of costs and benefits of actions related to climate change envisaged by the dominant resource-sharing perspective on climate ethics.

In light of these considerations, this article, which is the first step in a broader research project on moral judgement and decision-making in climate change, presents a confirmation of a moral approach to the harm-related moral dilemmas raised by climate change based on recent developments in — broadly understood — moral psychology. In particular, it argues that climate ethics, in order to increase its acceptability, should be based on the indications on relevant moral processes and judgements, that is, closer to the inner nature of the morality of human beings, which is shaped by the particular – impersonal – notion of harm caused by climate change. This contention is based on insights from moral cognitive neuroscience, which assumes that divergent moral theories/principles originate from human psychology, that cognitive neuroscientific methods are particularly useful for clarifying the consequent persistence of fault lines (i.e. moral dilemmas) between them, and that this understanding is morally significant and, in regard to the aim of this article, important for advancing a different moral approach to ~~the~~ climate ~~change~~ ethics. In the end, a moral approach to climate change focused on *impersonal harm*, which, as made clear by moral cognitive neuroscience, is consistent with human morality, can be more widely acceptable, due to its acknowledgment of the moral nature of climate change.

I also believe that such closeness to the structure of human morality makes this moral approach more politically feasible. In fact, as the literature on political science unambiguously points out (e.g. Dahl 1998), the more policymaking at any levels is consistent with people's values and beliefs, the more it is likely to succeed in the long term, at least in democratic societies, as Crompton (2011) argues specifically with regards to climate change. I maintain, in fact, that mainstream resource sharing approaches, by misconstruing the *justifying reason* that makes the climate crisis an urgent moral problem, i.e. harm and not the allocation of cost and benefits for dealing with climate change, crowds out the *motivating reason* that would urge agents to address it.

The vindication of this claim needs indeed more thorough and contextualised scrutiny, as underlined in the conclusion. Suffice it to say here that it is, in my opinion, justified by the internalist perspective of metaethical analysis (Rosati 2009), demanded by the global and intertemporal nature of climate change and by the multiplicity and dissimilarity of subjects involved. These features of the climate crisis require, in fact, a connection between moral judgement and motivation for overcoming political inertia.

Climate change's moral traits and the current approaches of mainstream climate ethics

Before discussing recent findings from moral cognitive neuroscience and their implications for climate ethics it is necessary to review in some more depth the relevant moral traits of climate change outlined above and the current approaches of mainstream climate ethics. As stated, the main moral dilemmas that characterise climate change are related to harm. However, such harm does not have the characteristics of an archetypal moral problem: i) intentionality on the part of harming subjects; ii) the possibility of identifying the harm and the harming and harmed subjects; and iii) proximity in time and space of the harm and the harming and harmed subjects. In fact, in the context of climate change, there is no clearly identifiable subject (agent) that acts intentionally in order to harm another clearly identifiable subject (victim), who is near in time and space. Rather, there are numerous agents who, through their ordinary actions (driving a car, working at a computer, eating meat), inadvertently and/or inevitably and/or ignorantly set in motion forces that will harm numerous victims distant in time and space.

Because it is not possible to identify agents and victims, the casual link between them and the relevant moral dimensions, harm arising from climate change is a distant and abstract one – an impersonal harm – that makes it easy to argue that '[w]e tend not to see climate change as a moral problem, it does not motivate us to act with the urgency characteristic of our responses to moral challenges' (Jamieson 2008, p. 546). Similarly, as anticipated, evolutionary psychology suggests that the human brain has evolved to cope with threats that relate to social intention, violate our moral sensibilities, are immediate, and are not too gradual to go undetected (Gilbert 2006). Climate change, indeed, lacks all these features, and therefore the human brain, according to evolutionary psychologists, is unprepared to respond to the challenges raised by the climate crisis.

The literature on the ethics of climate change, as emphasised, still mostly adheres to a perspective based on the duties of mitigation and adaptation that does not generally focus on the harm-related moral nature of the climate crisis, let alone on the type of the harm associated with it. This literature, in fact, continues mainly to confront climate change as a resource-sharing moral issue involving deontological thinking. Deontology judges the morality of states of affairs on the basis of their conformity with a moral norm, usually referring to

rights and/or duties that should be observed by any moral agent. It is usually juxtaposed to consequentialism, a moral approach that holds that acts and/or intentions are morally relevant, i.e. right, wrong or indifferent, only in virtue of their consequences, that is, of the state of affairs that they bring about. Briefly, deontology, as epitomised by Immanuel Kant, focuses on the Right, whereas consequentialism, as typified by John Stuart Mill, focuses on the Good.

To clarify, I do not argue that current climate ethics is wrong by largely adopting a deontological perspective on mitigation and adaptation duties. A large body of indisputable theoretical and experimental evidence demonstrates that deontological moral reasoning is widely adopted and effective in dealing with resource-sharing moral dilemmas (i.e. it is closer to the moral nature of ~~human beings~~; in fact, humans exhibit a strong commitment to fairness in these cases). For instance, the literature on behavioural economics and neuroeconomics (e.g. Kahneman *et al*. 1986, Camerer *et al*. 2005) has long established this point. Furthermore, I do not contend that it is wrong, *per se*, to frame climate ethics in relation to the duties of mitigation and adaptation; nor do I criticise the sophisticated ethical treatments that adopt this perspective. Rather, as pointed out in the introduction, I claim that this ethical focus risks receiving scant moral acceptance and may thus be politically problematic (i.e. it risks having poor *motivating reasons*) because it does not properly address the inner moral nature of climate change close to human morality defined by the impersonal harm produced by its effects (i.e. because of the erroneous understanding of the *justifying reasons*).

That being said, it is worthwhile to review the deontological perspective of ~~*mainstream*~~ climate ethics, which the alternative approach inspired by moral cognitive neuroscience proposed in the subsequent section intends to complement. The duty of mitigation – i.e. the duty to limit dangerous carbon emissions and enhancing their sinks – is commonly understood as a substantive, harm-independent resource-sharing moral issue grounded in deontological patterns of distribution (i.e. general distributive constructs) such as equality, priority and sufficiency. As a consequence, the principles of distribution (i.e. the translation of patterns of distribution into burden-sharing schemes) based on this understanding of climate ethics are necessarily deontological: for instance, the principle of *historical responsibility*, which allocates costs of emission abatement in proportion to subjects' past contributions to the overall level of emissions (Shue 1999). Other popular deontological principles for sharing the burden of mitigation derived from the above-mentioned patterns are *equal per capita* (Singer 2002), *equal burden* (Moellendorf 2009), *ability to pay* and *beneficiary pays* (Page 2008), *subsistence/luxury emissions* (Shue 1993) and *access to the ecological space*, that is, to the atmosphere's capacity to absorb GHG emissions (Hayward 2007). Caney (2009) offers instead a harm-related approach to climate change. He refers to the rights to life and health threatened by climate impacts, a profoundly deontological approach that, in my opinion, misspecifies the harm involved as a personal harm. Shue (2011, p. 305), while acknowledging the impersonality

of harm arising from climate change, by basing his arguments on the (indirect and impersonal) 'creation of circumstances', links the notion of harm to that of responsibility, thus remaining on deontological grounds.

In contrast, the less scrutinised duty of adaptation – i.e. the duty to support poor people in adapting to climate change and/or to compensate for the damage that it causes – refers almost exclusively to the harm generated by climate change. Nevertheless, as with the duty of mitigation, current climate ethics commonly addressed this duty from a deontological perspective, ignoring the impersonal nature of the harm involved. In particular, this perspective refers to an ill-defined no-harm moral rule that, independent of any considerations on the type of the harm involved, is grounded in the notions of responsibility and vulnerability, which produce obligations related to prevention and adaptation activities against climate impacts and to compensation for residual damages. Responsibility is generally based on some forms of contribution to the problem (retrospective responsibility) and capacity to pay (prospective responsibility) (Caney 2005, Paavola *et al.* 2006, Baer *et al.* 2008, Jagers and Duus-Otteström 2008). Vulnerability, considered by the UNFCCC at article 4.4 to be the basis for assisting developing countries in meeting the cost of adaptation to climate impacts, especially in its social understanding, commonly focuses instead on the right of subjects to rely on factors such as assets, sources of livelihood, institutional capacity for limiting climate harms (Kelly and Adger 2000).

Notably, also the policy debate on climate-related ethical issues has been largely shaped by (implicit) deontological claims. For instance, at the Copenhagen COP 15, China, India and the G77 and China group vocally argued for the deontological moral principle of historical responsibility, while the US delegation forcefully opposed it, and more generally resisted any appeal to justice. The recent Durban COP 17 saw the emergence of a stronger and more articulated demand by the developing world for a fairer climate regime, no more only exclusively focused on the unequal contribution to the problem but still grounded in deontological claims.

Moral cognitive neuroscience and its implications for climate ethics

Moral cognitive neuroscience may provide important aid in developing a harm-centred climate ethics. It is an emerging interdisciplinary field based on the integration of psychology, neuroscience, evolutionary biology and anthropology that 'aims to elucidate the cognitive and neural mechanisms that underlie moral behaviour' (Moll *et al.* 2005, p. 799). It seeks to find empirically-based explanations for moral judgement processes by studying interactions between three levels of analysis associated with moral cognition: the psychological level, which investigates the nature of relevant psychological states, their developmental origins and their cultural and evolutionary history; the cognitive level, which focuses on the pertinent information-processing mechanisms; and the neural level, which concerns the brain mechanisms and

regions involved. In other words, moral cognitive neuroscience applies approaches typically used by moral psychology (e.g. behavioural experiments, whereby participants are asked to carry out tasks involving moral decision-making) and cognitive neuroscience (e.g. brain imaging methods) to issues of interest to moral philosophy.

Psychology has traditionally understood moral judgement as a reasoning process characterised by higher cognition (Kohlberg 1969), however contemporary perspectives stress the central role emotions play in moral decision-making (Haidt 2001). Over the past few years, in fact, a wealth of studies have made it unambiguously clear that moral judgements are produced by the interaction between multiple cognitive systems (Greene 2008, Sinnott-Armstrong 2008, Cushman and Young 2009). Theories recognising the coexistence of emotion and cognition in decision-making are indeed not new: psychologists have long acknowledged the distinction between efficient, specialised, automatic processes and less efficient, slower mechanisms, involved in controlled processes (Cohen *et al*. 1990). Social cognitive neuroscience and neuroeconomics have similarly distinguished between an X-system (or system 1, the refleXive one), and a C-system (or system 2, the refleCtive one). The former involves parallel processing, a sub-symbolic pattern that produces a continuous, automatic stream of consciousness that quickly proposes answers to problems (Kahneman 2003, Camerer *et al*. 2005). The latter involves a controlled process that uses symbolic logic to produce conscious thoughts that monitor, and if necessary correct and override, the stream of consciousness generated by the X-system (Cohen 2005, Lieberman 2007). In particular, a growing body of evidence supported by neuroimaging methods (e.g. Greene *et al*. 2001, 2004, Casebeer 2003, Cushman *et al*. 2006, Koenigs 2007), demonstrates that moral judgement is accomplished both by reflexive and rational psychological processes and is produced by affective/emotional and cognitive/controlled cognitive systems.[3] Notably, such perspectives echo well-established philosophical schools of thought that acknowledge the role of the affective/emotional sphere in moral decision-making. For instance, virtue ethics rooted in ancient Greek philosophy, and especially in Aristotle, underlines the importance of affectivity in virtue, and of exploring the moral psychology of ~~the~~ emotions. In fact, Anscombe's seminal paper (1958) – prompted by growing dissatisfaction with the forms of deontology and consequentialism then prevailing – revitalised virtue ethics by greatly stressing the role of emotions in moral life, and of moral psychology for inscribing and understanding them in a virtue framework.[4]

Greene *et al*. (2001, 2004, 2008, Greene 2008 for an overall discursive overview, Cushman *et al*. 2010 for an effective synthesis) provide a promising foundation for the current analysis, due to the centrality of investigation of harm-related moral dilemmas to their research. Their investigations of the neural bases of moral judgement have developed a dual-process theory of morality, which confirms that both affective/emotional responses and cognitive/controlled ones play fundamental, and sometimes mutually competitive,

roles. Their work synthesises a long-standing cognitive paradigm in moral psychology, developed by Kohlberg (1969), which assumes that moral judgement is generated by conscious, rational reasoning on moral principles/theories applied to particular cases, with the more recent intuitionist approach developed by Haidt (2001), which holds that moral judgement is grounded in intuitions generated by unconscious, automatic cognitive processes for which conscious reasoning provides a post hoc moral justification.

Greene and colleagues focus on moral dilemmas related to 'physically harmful behavior' (Cushman *et al*. 2010, p. 48). They define a moral dilemma as personal if it causes direct, serious bodily harm to a particular person or set of people; if on the contrary, it involves no serious physical harm, harm only to indefinite victims (this in the case of climate change, as discussed in the previous section) or only demands diverting some pre-existing threat onto different victims rather than producing the harm oneself, the dilemma is impersonal. Briefly, their personal moral dilemmas satisfy the 'ME HURT YOU' (Greene *et al*. 2004, p. 389, capitalised in the original) condition.[5]

On the basis of this categorisation of harm, Greene and colleagues advance descriptive, normative and metaethical implications for deontological and consequentialist moral reasoning. It is worth noting that they use *consequentialism* and *utilitarianism* interchangeably. However, I prefer to use consequentialism consistently throughout this article because of its wider philosophical breadth. Furthermore, despite the many forms of consequentialism, I argue that the dual-process theory seems to endorse a non-maximising version of consequentialism. This perspective, found in *satisficing consequentialism* and *progressive consequentialism*, whose deontic principal only require improving the states of affairs, is, in fact, less demanding and more practically feasible.

In order to grasp the usefulness of Greene's *et al*. work on the specific implications of the moral nature of harm for moral thinking and to apply them to climate ethics, it is necessary to detail their main arguments more closely. They first explore the role of affective/emotional and cognitive/controlled cognitive systems in harm-related moral dilemmas similar to those that characterise the classic switch/footbridge trolley problem scenarios (Foot 1967, Thomson 1985). In the first case a runaway trolley is on course to kill five people and they can be saved save only by hitting a switch that would put the trolley onto another track where it would kill one person. The footbridge scenario is similar, but those five people can only be saved by pushing a very large man capable of stopping the trolley off the bridge and onto the track, thus causing his death. Even though both scenarios involve one person dying to save five others, most people condemn the footbridge case, while they favour trading one life for five in the switch scenario, independently of biological and cultural differences (Greene *et al*. 2001, 2004): an inconsistency that, according to Greene (2008), philosophers are unable to satisfactorily explain. Greene *et al*. (2001, 2004) hypothesise that the divergent responses to the trolley problem depend on the emotional contents of the harming action: that of the switch case is less significant because the harm, similarly to what happens in the

context of climate change, is brought about in an impersonal way (i.e. by hitting a switch), whereas in the footbridge case the harm (i.e. pushing a man off a bridge) is *up, close and personal* and triggers alarm bell-like emotions that override more controlled responses. They further argue that such alarm bell emotions are rooted in our genes, as evolutionary psychology suggests, because the emotional aversion to harming other humans evolved as a strategy that allowed people to build stable social structures that gave them an advantage over other species (Cohen 2005, Singer 2005, Greene 2008). In contrast, the impersonal switch scenario fails to prompt such alarm bell emotions and therefore allows cognitive/controlled moral reasoning.

Greene and colleagues tested this hypothesis empirically by scanning the brain activation produced by behavioural experiments on harm-related issues consistent with the trolley problem scenarios using functional magnetic resonance imaging (fMRI) (Greene *et al*. 2001). As predicted, they found that impersonal cases, like in the switch scenario, generate greater activity in brain areas associated with effortful, cognitive/controlled reasoning (the dorsolateral prefrontal cortex and the inferior parietal lobe), while personal cases, like in the footbridge scenario, yield greater activation of affective/emotional brain areas (the posterior cingulated cortex, the medial prefrontal cortex and the amygdale). Greene *et al*. also showed that subjects who consider the personal harm scenario morally acceptable have to override strong emotions, as made evident by the longer time needed to reach this moral judgement. In a subsequent study, Greene *et al*. (2004) proved that consequentialist reasoning needs additional cognitive control in difficult moral dilemmas that impose a choice between saving one life and many lives. This is detectable from the activation of the anterior cingulated cortex that signals this need to the classical cognitive areas of the brain, especially the dorsolateral prefrontal cortex in their experiments. Finally, Greene *et al*. (2008) observed that cognitive load selectively interferes with consequentialist moral reasoning, thus supporting the claim that this is preferentially carried out by controlled cognitive processes.

The dual-process theory ultimately reveals two different processes of moral judgement: a (predominantly) emotional one, largely prompted by direct personal harm, that aims at the right, and a (predominantly) cognitive one, triggered by and large by impersonal harm, that supports the maximisation of the overall good. Which of the two processes is more intensely activated determines the final moral judgement (Cushman and Young 2009). According to the authors, a sensible interpretation of these findings, evinced by observation of brain activity, is that the first process involves deontological reasoning and the second consequentialist reasoning (Greene 2008). Numerous independent studies support this deontology/emotions–consequentialism/cognition interpretation (e.g. Kahneman *et al*. 1998, Baron *et al*. 2001, Haidt *et al*. 2003, Koenigs *et al*. 2007, Moore *et al*. 2011). Others dispute this conclusion on various grounds. For instance, based on their study of patients with damage to the ventromedial prefrontal cortex, Moll *et al*. (2005) suggested that a decrease

in *prosocial moral sentiment* – a single process – is sufficient to explain the increase in consequentialist moral judgement. McGuire *et al.* (2009), reanalysing Greene's *et al.* (2001) data, point out a serious flaw in response time that may undermine the understanding of the distinction between personal and impersonal moral dilemma and, therefore, the significance of the whole dual-process theory. Kahane *et al.* (2011) use an fMRI experiment to show that consequentialist and deontological judgements are not associated with distinct neural systems. Klein (2011) criticises the neuroimaging evidence supporting the distinct activation of emotional or cognitive processes produced by the moral dilemmas observed by the dual-process theory. In all, Greene (forthcoming) vividly illustrates the different judgement processes of the moral brain through the *camera analogy*: like a camera, our moral brain has both (easy) *automatic settings* that produce efficient intuitive emotional responses – that is, deontological reasoning – for straightforward, familiar moral problems, and (difficult) *manual settings* that make it possible to carry out flexible, deliberate moral reasoning – that is, consequentialist reasoning – for complex and unfamiliar moral problems, such as climate change.

A *caveat* is in order. As Greene acknowledges, by treating deontology and consequentialism as '*psychological natural kinds*', that is, 'philosophical manifestations of two dissociable psychological patterns, two different ways of moral thinking' (Greene 2008, p. 37, emphasis in the original) and by focusing on their functional role as seen in their empirical evidence, Greene's *et al.* argument runs counter to the philosophical tradition that assumes that deontology, being a rule-based morality founded in the respect of a norm, operates on the basis of rational moral judgement, whereas consequentialism is associated with the Humean sentimentalist tradition (Cushman *et al.* 2010). Based on the evidence provided, the authors ultimately infer that, while moral judgement depends critically on both approaches, consequentialist reasoning, grounded in controlled, sophisticated, and distinctively human cognitive processes, is superior to deontological reasoning, grounded in emotional, automatic, unsophisticated and relatively unaltered and unchangeable cognitive processes (Greene 2008, Cushman *et al.* 2010).

While I grant the central evidence emerging from Greene's and colleagues work about the association of direct and indirect harm with deontology and consequentialism, respectively (although I acknowledge some of the criticisms made to this perspective, discussed above), I believe that their more general attack on deontology needs further careful consideration, as many unconvinced scholars demand. For instance, Allman and Woodward (2008) suggest another interpretation of Greene's *et al.* results: the role of emotion increases with the complexity of the moral decision; therefore, emotion-based deontological reasoning would work with difficult moral processes, while consequentialist moral thinking would be employed in simpler situations. Dean (2010) confutes Greene and colleagues' conclusion that consequentialism is superior to deontology, disproving the two main anti-deontological claims central to their thesis, namely the unreliability of emotional responses

associated with deontology to ground a moral theory, and the *mere* post-hoc rationalisation role of deontological moral reasoning, on philosophical bases. Dean argues further that these assumptions are *per se* unproven and, additionally, imply that rationalism is superior to emotivism, which moral neuroscience seems as yet unable to justify to metaethics (Joyce 2008). On more strictly philosophical grounds, Berker (2009) argues that attempts to derive normative implications from neuroscience are either based on poor inference or appeal to non-significant moral intuitions. Kamm (2009) discusses the moral relevance of personal factors for exploring deontological responses in fMRI studies. Furthermore, she raises doubts about the possibilities of drawing normative conclusions from neuroscientific data, because they rely on hypothetical experimental data. Less radically, Timmons (2008) suggests that Greene et al.'s arguments apply only to some forms of deontology, not to all deontological moral theories.

Ultimately, in this article, I simply assume the fundamental, and less controversial, result of Greene *et al.*'s fMRI studies, namely, that impersonal harm-related moral dilemmas are based on reflective, cognitive moral processes that prompt consequentialist moral thinking, whereas moral dilemmas associated with personal harm activate automatic emotional processes that lead to deontological reasoning. In fact, this finding thoroughly addresses the harm-related nature of climate ethics, as discussed in the previous section, making it possible to shape a more acceptable approach (consequentialist, in fact) to the relevant moral dilemmas. A discussion of Greene *et al.*'s anti-deontological arguments is, therefore, far beyond the scope of the article.

What implication does the dual-process theory have for climate ethics? To put it plainly, this approach highlights the impersonal nature of the harm found in moral dilemmas similar to those of climate change and the resultant necessity of addressing them through consequentialist moral reasoning, and, on the other hand, the lack of the kind of personal threat that would activate the (predominantly) emotional response upholding the deontological approaches invoked by mainstream climate ethics. In other words, human morality does not envision climate change as a *deontological* moral issue. However, this does not mean that the moral brain cannot construe climate change as a moral issue *tout court*. In particular, the dual-process theory suggests that avoiding/preventing harm, the ultimate moral dilemma of climate change, originates from a relatively impersonal moral violation. Therefore, climate change *is* a moral issue, one to which we can therefore usefully apply consequentialist moral reasoning because of its consistency with human morality, and perhaps because of its possibly greater political feasibility.

Conclusion

Overall, climate change is an *unfamiliar* moral problem that we do not know *well*. It is unfamiliar because we do not possess the relevant knowledge gained

from trial and error experience, and we still fail to understand it well largely because of the problems pointed out in the introduction. As such, current deontological climate ethics generally frames climate change as a substantive resource-sharing moral problem, and does not take account of the impersonal nature of the harm that it generates. These approaches, therefore, do not resonate with human morality, and ultimately cannot capture the inner moral nature of climate change. The dual-process theory alternatively suggests that consequentialist approaches aimed at improving overall welfare offer a suitable moral approach to climate change, owing to their greater consistency with human morality. Therefore, moral cognitive neuroscience's ultimate contribution to climate ethics resides in its support for consequentialism, not only because of its higher efficiency and effectiveness (Böhringer and Helm 2008), but because of its consistency with human morality. All in all, even though this would ultimately even dispute the deontological ethical provisions of the UNFCCC, we should 'do what will produce the best consequences' (Singer 2005, p. 346).

By way of conclusion, it is necessary to point out that the application of neuroscientific evidence to climate ethics is still in its infancy, this article being, as said, the first step in a broader research project on moral judgement and decision-making in climate change. Hence much more work is needed and, to some extent, some is forthcoming. In particular, besides the definition of a consequentialist architecture for climate ethics, two main avenues of research seem to me particularly urgent. First, it is imperative to conduct novel ~~fMRI~~ experiments specifically tailored to the features of climate-related harm, because those carried out by Greene and colleagues on personal and impersonal moral dilemmas consistent with the trolley problem scenarios (Greene *et al*. 2001, 2004, 2008) are characterised by forms of harm alien to the reality of climate change. In fact, as Mikhail (2011, p. ~~234~~) points out, all 25 Greene and colleagues' personal dilemmas 'involve serious bodily injury' and in 24 out of 25 cases respondents are subject to 'violent crimes and torts'. By contrast, 'five of the 19 cases of ''impersonal'' condition are batteries . . . [t]he remaining 14 ''impersonal'' scenarios are a hodgepodge of cases that raise a variety of ethical and legal issues, including fraud, tax evasion, insider trading, public corruption, theft, unjust enrichment, and necessity as a defense to trespass to chattels' (Mikhail 2011, p. ~~234~~). A second critical line of further analysis relates to the not yet justified, but in my opinion sensible and indeed very important, claim made at the end of the introduction concerning the likely greater political feasibility of consequentialist climate ethics due to its closer consistency with human morality. This is fundamentally a metaethical issue that involves understanding of the phenomenon of moral motivation in relation to the nature of moral judgements. I believe that this point requires thorough analysis specifically conducted in view of the moral dimensions of climate change with the support of moral and social psychology.

Acknowledgements

I would like to thank Tommaso Bruni, Ben Fraser, ~~Viviana Di Giovinazzo,~~ Giuseppe Feola, Simona Sacchi and two anonymous referees for their comments and suggestions on earlier drafts of this article.

Notes

1. A second, less-widespread perspective does not rely on the notion of harm at all, instead conceiving of climate ethics as a cost-sharing problem generated by the joint effort to promote a common good, climate stability. A third one, found in welfare economics and largely based on the expected utility theory, argues that what counts for climate ethics is not harm and its likeliness but the small chance of a climate catastrophe: at best a seriously partial view, in my opinion. Alternative holistic approaches, such as deep ecology, which stresses the interdependence of human beings and the ecosphere and claims that both humans and the living environment have the same right to live and flourish, try to develop eco-centric climate ethics. However, as emphasised, I believe that the nature of the climate crisis suggests the moral prominence of the standpoint focused on (impersonal) harm.
2. For the first, see for instance Gardiner (2010), Caney (2010), Moellendorf (2009), Page (2008), Singer (2002), Shue (1993). Some of the ethical facets of the adaptation duty, which remains relatively unexplored, have been directly addressed through investigations of moral principles for allocating the costs of climate change, e.g. Baer *et al*. (2008), Jagers and Duus-Otteström (2008), indirectly addressed through the individuation of responsibility for climate burdens, e.g. Page (2008), Paavola *et al*. (2006), Caney (2005), and confronted through an integrated framework for adaptation funding focused both on the distributive and procedural dimensions of justice (Grasso 2010).
3. When speaking of *cognitive/controlled* cognitive systems, *cognitive* is used in a narrow sense as the opposite of affective/emotional. In this understanding, cognitive processes are slow, effortful and voluntary, in contrast to affective/emotional processes, which are rapid, effortless and involuntary (Cushman *et al*. 2010). Broader uses of the term *cognitive* instead refer to information processing.
4. This line of inquiry is ascribable to the sentimentalist tradition of moral philosophy epitomised by David Hume (1711–76) and Adam Smith (1723–90), who derive ~~the~~ moral sentiments from the operation of sympathy, i.e. the predisposition to feel other people's feelings.
5. I should note that Greene and colleagues regard the distinction between the personal and impersonal as a first-cut for distinguishing the cognitive bases of moral issues (Greene *et al*. 2004), an assumption that is refuted by some scholars (e.g. Mikhail 2011). However, *prima facie*, the personal/impersonal distinction seems sufficient to support in this article my line of reasoning in climate ethics. As pointed out in the conclusion, however, further work is needed on climate-related harm functional magnetic resonance imaging (fMRI) evidence.

References

Allman, J. and Woodward, J., 2008. What are moral intuitions and why should we care about them? A neurobiological perspective. *Philosophical Issues*, 18, *Interdisciplinary Core Philosophy*, 164–185.

Anscombe, G.E.M., 1958. Modern moral philosophy. *Philosophy*, 33 (124), 1–19.

Baer, P., *et al*., 2008. Greenhouse development rights: towards an equitable framework for global climate policy. *Cambridge Review of International Affairs*, 21 (4), 649–669.

Baron, J., 2006. Thinking about global warming. *Climatic Change*, 77 (1–2), 137–150.

Baron, J., *et al*., 2001. Analog scale, ratio judgment and person trade-off as utility measures: biases and their correction. *Journal of Behavioral Decision Making*, 14, 17–34.
Berker, S., 2009. The normative insignificance of neuroscience. *Philosophy & Public Affairs*, 37 (4), 293–329.
Böhringer, C. and Helm, C., 2008. On the fair division of greenhouse gas abatement cost. *Resource and Energy Economics*, 30 (2), 260–276.
Camerer, C.L., Loewenstein, G., and Prelec, D., 2005. Neuroeconomics: how neuroscience can inform economics? *Journal of Economic Literature*, 43 (1), 9–64.
Caney, S., 2005. Cosmopolitan justice, responsibility and global climate change. *Leiden Journal of International Law*, 18 (4), 747–775.
Caney, S., 2009. Climate change, human rights and moral threshold. *In:* S. Humphrey, ed. *Human rights and climate change*. Cambridge, Cambridge University Press, 69–90.
Caney, S., 2010. Climate change and the duties of the advantaged. *Critical Review of International Social and Political Philosophy*, 13 (1), 203–228.
Casebeer, W.D., 2003. Moral cognition and its moral constituents. *Nature Review Neurosciences*, 4, 841–846.
Chen, X., 2011. Why do people misunderstand climate change? Heuristics, mental models and ontological assumptions. *Climatic Change*, 108 (1–2), 31–46.
Cohen, J.D., 2005. The vulcanization of the human brain: a neural perspective on interactions between cognition and emotion. *Journal of Economic Perspectives*, 19 (4), 3–24.
Cohen, J.D., Dunbar, K., and McClelland, J.L., 1990. On the control of automatic processes: a parallel distributed processing account of the Stroop effect. *Psychological Review*, 97 (3), 332–361.
Crompton, T., 2011. Values matter. *Nature Climate Change*, 1 (6), 276–277.
Cushman, F. and Young, L., 2009. The psychology of dilemmas and the philosophy of morality. *Ethical Theory and Moral Practice*, 12 (1), 9–24.
Cushman, F., Young, L., and Greene, J.D., 2010. Our multi-system moral psychology: towards a consensus view. *In*: J. Doris *et al*., eds. *The Oxford handbook of moral psychology*. Oxford: Oxford University Press, 47–71.
Cushman, F.A., Young, L., and Hauser, M.D., 2006. The role of reasoning and intuition in moral judgements: testing three principles of harm. *Psychological Science*, 17 (12), 1082–1089.
Dahl, R., 1998. *On democracy*. New Haven, CT: Yale University Press.
Dean, R., 2010. Does neuroscience undermine deontological theories? *Neuroethics*, 3 (1), 43–60.
Foot, P., 1967. The problem of abortion and the doctrine of double effect. *Oxford Review*, 5, 5–15.
Gardiner, S., 2004. Ethics and global climate change. *Ethics*, 114 (3), 555–600.
Gardiner, S., 2010. Ethics and climate change: an introduction. *Wiley Interdisciplinary Reviews: Climate Change*, 1 (1), 54–66.
Gardiner, S., 2011. Some early ethics of geoengineering the climate: a commentary on the values of the Royal Society Report. *Environmental Values*, 20, 163–188.
Gert, B., 2011. The definition of morality. *In*: E.N. Zalta, ed. *The Stanford Encyclopedia of Philosophy*. Summer ed. Available from: http://plato.stanford.edu/archives/sum2011/entries/morality-definition [Accessed 20 May 2012].
Gilbert, D.T., 2006. *Stumbling on happiness*. New York: Knopf.
Gore, A., 2007. Moving beyond Kyoto. *The New York Times*, 1 July, p. 413 (New York edition). Available from: http://www.nytimes.com/2007/07/01/opinion/01gore.html [Accessed 20 May 2012].
Grasso, M., 2010. An ethical approach to climate adaptation finance. *Global Environmental Change*, 20 (1), 74–81.
Greene, J.D., 2008. The secret joke of Kant's soul. *In*: W. Sinnott-Armstrong, ed. *Moral psychology, vol. 3: the neuroscience of morality: emotion, disease, and development*. Cambridge: MIT Press, 35–79.

AQ3 Greene, J.D., forthcoming. *The moral brain and how to use it*. New York: Penguin Press.
Greene, J.D., *et al*., 2001. An fMRI investigation of emotional engagement in moral judgement. *Science*, 293, 2105–2108.
Greene, J.D., *et al*., 2004. The neural basis of cognitive conflict and control in moral judgement. *Neuron*, 44, 389–400.
Greene, J.D., *et al*., 2008. Cognitive load selectively interferes with utilitarian moral judgment. *Cognition*, 107 (3), 1144–1154.
Haidt, J., 2001. The emotional dog and its rational tail: a social intuitionist approach to moral judgement. *Psychological Review*, 108, 814–834.
Haidt, J., Rosenberg, E., and Hom, H., 2003. Differentiating diversities: moral diversity is not like other kinds. *Journal of Applied Social Psychology*, 33, 1–36.
Hansen, J., 2010. Obama's second chance on the predominant moral issue of this century. *The Huffington Post* [online], 5 April. Available from: http://www.huffingtonpost.com/dr-james-hansen/obamas-second-chance-on-c_b_525567.html [Accessed 20 May 2012].
Hayward, T., 2007. Human rights versus emissions rights: climate justice and the equitable distribution of ecological space. *Ethics and International Affairs*, 21(4), 431–450.
Intergovernmental Panel on Climate Change (IPCC), 2007a. *Climate change 2007 – the physical science basis. Working Group I contribution to the Fourth Assessment Report of the IPCC*. Cambridge: Cambridge University Press.
Intergovernmental Panel on Climate Change (IPCC), 2007b. *Climate change 2007 – impacts, adaptation and vulnerability: Working Group II contribution to the Fourth Assessment Report of the IPCC*. Cambridge: Cambridge University Press.
Jagers, S.C. and Duus-Otteström, G., 2008. Dual climate change responsibility: on moral divergence between mitigation and adaptation. *Environmental Politics*, 17 (4), 576–591.
Jamieson, D., 2008. The post-Kyoto climate: a gloomy forecast. *The Georgetown International Environmental Law Review*, 20 (4), 537–551.
Jamieson, D., 2010. Climate, nature and ethics: an editorial essay. *Wiley Interdisciplinary Reviews: Climate Change*, 1, 621–623.
Joyce, R., 2008. What neuroscience can (and cannot) contribute to metaethics? *In*: W. Sinnott-Armstrong, ed. *Moral psychology, vol. 3: the neuroscience of morality: emotion, disease, and development*. Cambridge: MIT Press, 371–394.
Kahane, G., *et al*., 2011. The neural basis of intuitive and counterintuitive moral judgment. *Social Cognitive and Affective Neuroscience*, doi: 10.1093/scan/nsr005.
Kahneman, D.A., 2003. Mapping bounded rationality: psychology for behavioural economics. *American Economic Review*, 93 (5), 1449–1475.
Kahneman, D.A., Knetsch, J., and Thaler, R., 1986. Fairness and the assumptions of economics. *Journal of Business*, 59 (4), 285–300.
Kahneman, D., Schkade, D., and Sunstein, C., 1998. Shared outrage and erratic awards: the psychology of punitive damages. *Journal of Risk and Uncertainty*, 16, 49–86.
Kamm, F.M., 2009. Neuroscience and moral reasoning: a note on recent research. *Philosophy & Public Affairs*, 37 (4), 330–345.
Kamminga, M., 2008. The ethics of climate politics: four modes of moral discourse. *Environmental Politics*, 17 (4), 660–672.
Kelly, P. and Adger, W.N., 2000. Theory and practice in assessing vulnerability to climate change and facilitating adaptation. *Climatic Change*, 47, 325–352.
Klein, C., 2011. The dual track theory of moral decision-making: a critique of the neuroimaging evidence. *Neuroethics*, 4 (2), 143–162.
Koenigs, M., *et al*., 2007. Damage to prefrontal cortex increases utilitarian moral judgement. *Nature*, 446, 908–911.
Kohlberg, L., 1969. Stage and sequence: the cognitive developmental approach to socialization. *In*: D.A. Goslin, ed. *Handbook of socialization theory and research*. New York: Academic Press, 151–235.

Lieberman, M.D., 2007. Social cognitive neuroscience: a review of core processes. *Annual Review of Psychology*, 58, 259–289.
McGuire, J., *et al*., 2009. A reanalysis of the personal/impersonal distinction in moral psychology research. *Journal of Experimental Social Psychology*, 45 (3), 577–580.
Mikhail, J., 2011. Emotion, neuroscience, and law: a comment on Darwin and Greene. *Emotion Review*, 3 (3), 293–295.
Moellendorf, D., 2009. Treaty norms and climate change mitigation. *Ethics & International Affairs*, 23 (3), 247–265.
Moll, J., *et al*., 2005. The neural basis of human moral cognition. *Nature Review Neurosciences*, 6, 799–809.
Moore, A.B., *et al*., 2011. In defense of the personal/impersonal distinction in moral psychology research: cross-cultural validation of the dual process model of moral judgement. *Judgment and Decision Making*, 6 (1), 186–195.
Paavola, J., Adger, W.N., and Huq, S., 2006. Multifaceted justice in adaptation to climate change. *In*: W.N. Adger *et al*., eds. *Fairness in adaptation to climate change*. Cambridge: MIT Press, 263–277.
Page, E.A., 2008. Distributing the burden of climate change. *Environmental Politics*, 17 (4), 556–575.
Rosati, C.S., 2009. Moral motivation. *In:* E.N. Zalta, ed., *The Stanford Encyclopedia of Philosophy*. Spring ed. Available from: http://plato.stanford.edu/archives/spr2009/entries/moral-motivation [Accessed 20 May 2012].
Schuppert, F. 2011. Climate change mitigation and intergenerational justice. *Environmental Politics*, 20 (3), 303–321.
Shklar, J.N., 1990. *The faces of injustice*. New Haven, CT: Yale University Press.
Shue, H., 1993. Subsistence emissions and luxury emissions. *Law and Policy*, 15 (1), 39–59.
Shue, H., 1999. Global environment and international inequality. *International Affairs*, 75, 531–545.
Shue, H., 2011. Human rights, climate change, and the trillionth ton. *In*: D.G. Arnold, ed. *The ethics of global climate change*. Cambridge: Cambridge University Press, 292–314.
Simon, T., 1995. *Democracy and social injustice: law, politics and philosophy*. Boston, MA: Rowman and Littlefield.
Singer, P., 2002. One atmosphere. *In*: P. Singer, *One world: the ethics of globalization*. New Haven, CT: Yale University Press, Chapter 2, 14–50.
Singer, P., 2005. Ethics and intuitions. *The Journal of Ethics*, 9 (3–4), 331–352.
Sinnott-Armstrong, W., 2008. Abstract+Concrete=Paradox. *In*: S. Nichols and J. Knobe, eds. *Experimental philosophy*. New York: Oxford University Press, 209–230.
Stehr, N. and von Storch, H., 2005. Introduction to papers on mitigation and adaptation strategies for climate change: protecting nature from society or protecting society from nature? *Environmental Science & Policy*, 8 (6), 537–540.
Sunstein, C., 2006. The availability heuristic, intuitive cost–benefit analysis, and climate change. *Climatic Change*, 77 (1–2), 195–210.
Thomson, J.J., 1985. The trolley problem. *The Yale Law Journal*, 94, 1395–1415.
Timmons, M. 2008. Toward a sentimentalist deontology. *In*: W. Sinnott-Armstrong, ed. *Moral psychology, vol. 3: the neuroscience of morality: emotion, disease, and development*. Cambridge: MIT Press, 93–104.
Vanderheiden, S., 2011, Globalizing responsibility for climate change. *Ethics and International Affairs*, 25 (1), 65–84.
Wolgast, E.H., 1987. *The grammar of justice*. Ithaca, NY: London: Cornell University Press.