sciendo

Ethics & Bioethics (in Central Europe), 2024, 14 (1–2), 61–71 DOI:10.2478/ebce-2024-0005

Ethical implications of epigenetic studies: On *ghost damage*

Mar Cabezas[1]

Abstract

Considering the recent epigenetic studies on the transgenerational transmission of trauma, this article aims to 1) explore its ethical implications for the concept and nature of moral damage, and 2) offer normative suggestions on collective responsibilities both synchronic and diachronic. To do so, I first address recent epigenetic studies' showing the crystallization of emotional information through generations, and second, defend that a unified approach to the concept of *ghost damage* may be useful to categorize this phenomenon, facilitate future research on this type of moral damage, and recognize its importance in the identification of hermeneutical injustice**.** Finally, I suggest that granting a right to transgenerational information may help avoid the perpetuation of inherited damage that jeopardize mental and physical health in the offspring.

Keywords: moral damage; transgenerational trauma; epistemic injustice; epigenetics; emotional injustice.

Epigenetics research and inherited moral damage

In this section I present the most relevant recent results, from an ethical perspective, on the epigenetic transmission of trauma to latter argue how all of them may result in a particular type of moral damage, due to their peculiar characteristics, namely, *ghost damage*.

Epigenetics studies heritable changes in gene function that occur without changes in the DNA sequence. For a long time, these changes had been considered as a kind of waste without much weight. However, epigenetic processes are increasingly considered as a molecular mechanism involved in transgenerational transmission, since "the expression of genes is in part regulated by epigenetic influences and environmental exposure can alter functional genetic expression, without altering the underlying genetic sequence, and as such affect behavior" (Branje et al., 2020, p. 100835). Thus, environmental factors, such as stress or significant emotional trauma (Meaney & Szyf, 2005) can affect psychosocial functioning (Barker et al., 2018), leading to changes in gene expression.

High-impact emotional experiences also leave a mark at this level, with the non-coding DNA containing encrypted emotional information being responsible for inherited emotional, behavioral and personality traits (Vendramini, 2005). This gives rise to a kind of intergenerational memory at the epigenetic level with consequences for people's well-being: "while coding genes moderate physical evolution, ncDNA[2] moderates emotional and behavioural evolution" (Vendramini, 2005, p. 513). As Vendramini points out, "traumatic life experiences – the death of a spouse, accidents, war, love and other highly emotional circumstances can precipitate a teemic mutation in human ncDNA" (Vendramini, 2005, p. 516).

Some of the most eye-catching experiments on the transgenerational transmission of trauma are those related to olfactory memory in mice (Gapp et al., 2014a; Gapp et al., 2020; Lewis, 2013).These experiments show how fear of an odor can be transgenerationally transmitted without prior exposure to said odor in the offspring, so that parental olfactory experiences with an emotional impact "crystallize" in the neuronal structure of the following generations (Dias & Ressler, 2014; Geddes, 2013).

In these experiments on olfactory emotional memory, fear of the smell of cherry blossoms was conditioned through electric shocks. After a period of time, researchers were able to identify changes in the sperm of these mice (Immler, 2018). As a result, the second and third generations, no longer subjected to the adverse conditioning, became startled and showed stress

[1] University of Salamanca (Spain), email: marcabezas@usal.es; ORCID: 0000-0001-9137-5972

[2] Non-coding DNA.

when exposed to this smell for the first time. Thus, following generations not only inherited a special sensitivity to this smell, but also the emotional response of stress. DNA methylation was low in the offspring, the same as in the first generation, even without having experienced the stressful experience. In short, the parent's traumatic experience was crystallized in their DNA, transmitting this emotionally important information to the following generations (Lewis, 2013; Geddes, 2013, Dias & Ressler, 2014).

In addition:

> Independent studies have observed that a paternal history of stress or trauma is associated with his children having a greater likelihood of developing psychopathologies such as anxiety disorders. This father-to-child effect is reproduced in several mouse models of stress, which have been crucial in developing a greater understanding of intergenerational epigenetic inheritance (Fennell et al., 2020, p. 16050).

Although this learning may be beneficial, as it biologically prepares us to "memorise environmental conditions" (Immler, 2018, p. 244) to be able to face the traumas that our parents suffered, what is relevant here for the idea of moral damage is that "traumatic experiences in childhood can alter behavioural responses and increase the risk for psychopathologies across life, not only in the exposed individuals but also in their progeny" (Gapp et al., 2014b, p. 1).

In line with these experiments, these researchers state that "adverse environmental conditions in early life can alter stress responses and affect behavioural and cognitive functions in adulthood. Further, they often not only affect the individuals directly exposed to these conditions but also their progeny" (Gapp et al., 2014b, p. 2). That is, the effects of exposure to traumatic and stressful experiences—and, in this sense, a source of moral damage—can be transmitted to following generations and affect progeny in a similar way to how it affected ancestors, this time in the absence from any trauma or exposure to stress (Gapp et al., 2016).

Other studies, also with mice, show the transgenerational emotional imprint, not through fear of a smell, but by generating post-traumatic stress due to separation, concluding that:

> Exposure of male pups to traumatic stress involving repeated episodes of unpredictable maternal separation combined with unpredictable maternal stress (MSUS), leads to depressive-like behaviors, altered risk assessment and impaired social interactions in adulthood across several generations. (…) Postnatal traumatic stress in males can affect brain plasticity and cognitive functions in the adult progeny, possibly through epigenetic alterations in the male germline. (…) The offspring of males subjected to postnatal traumatic stress have decreased gene expression in molecular pathways necessary for neuronal signaling, and altered synaptic plasticity when adult. Long-term potentiation is abolished and long-term depression is enhanced in the hippocampus, and these defects are associated with impaired long-term memory in both the exposed fathers and their offspring (Bohacek & Mansuy, 2015, p. 621).

As Gapp and her team state, "adverse experiences can have long-term transgenerational effects on mental and physical health, and often increase disease risk (…) [just as] alterations in long RNA in sperm contribute to the inheritance of specific trauma symptoms" (Gapp et al., 2020, p. 2162). In this same line, her previous research concluded that "traumatic stress in early life altered mouse microRNA (miRNA) expression, and behavioral and metabolic responses in the progeny" and, what is more, that "the injection of sperm RNA from traumatized males into fertilized wild-type oocytes reproduced the behavioral and metabolic alterations in the resulting offspring" (Gapp et al., 2014a, p. 667). This is consistent with the studies conducted by Zheng and his team, who also state that "sperm epigenetic alterations contribute to inter- and

transgenerational effects of paternal exposure to long-term psychological stress" (Zheng et al., 2021, p. 1).

In relation to collective events, one of the most notable researchers is R. Yehuda, as she has demonstrated, in the context of the Holocaust, that the descendants of the survivors carry the physical and emotional symptoms of traumas that they have not directly experienced. That is, they suffer the effects of damage without having suffered the damage, at an epigenetic level, without the need for conscious or narrative transmission of family stories. In fact, many of these damages date back three generations, with the second and third generations being unaware of the initial traumatic event that occurred to their ancestor (Yehuda et al., 2014; 2016). The children of those Jews who had lived traumatic experiences during the Holocaust shared a similar genetic pattern, namely, epigenetic changes that could only be explained by the traumas experienced by that previous generation, not by themselves. Thus, the role of the transgenerational transmission of trauma can be observed in the epigenetic mechanisms of depression and in how the descendants of Holocaust survivors have alarmingly low levels of cortisol, typical of those who have suffered a situation of prolonged stress over time (Yehuda et al., 2000, p. 1255; Rodríguez, 2015).

Several studies are also consistent with these results, such as those by Gapp and Franklin (2021), who state that "the children of Holocaust survivors exhibited differential DNA methylation at (…) a gene that encodes a key cofactor of the main stress hormone receptor, glucocorticoid receptor, when compared to individuals not living in Europe during the second world war" (Gapp & Franklin, 2021, pp. 775–776); or those by Lehrner and his team, who affirm that:

> The intergenerational effects of trauma have been observed clinically in a wide range of populations, and parental PTSD[3] has been associated with an increased risk for psychopathology in offspring. In studies of Holocaust survivor offspring, parental PTSD, and particularly maternal PTSD, has been associated with increased risk of PTSD, low basal urinary cortisol excretion and enhanced cortisol suppression in response to dexamethasone. Such findings implicate maternally derived glucocorticoid programming in the intergenerational transmission of trauma-related consequences (…). Maternal PTSD was associated with greater sensitivity to glucocorticoid sensitivity in offspring (…). These findings are consistent with the hypothesis that epigenetic programming may be involved in the intergenerational transmission of trauma-related effects on glucocorticoid regulation (Lehrner et al., 2014, p. 213).

Something similar occurs with other collective historical experiences. It has been shown (Roth et al., 2014) that young people who were born in Rwanda after 1994 exhibit the same symptoms of post-traumatic stress as those who witnessed, survived, and were traumatized by it, a phenomenon that is repeated in studies with Native American Indian survivors (Pember, 2015). In the case of the Cherokee Indians, it has been proven that the suicide rates of descendants who did not experience the traumatic event firsthand are, however, high (Bender, 2015).

Finally, studies on the accumulation of microtrauma or mild, but chronic, experiences of stress over generations deserve mention, such as that of Ambeskovic and her team, who conclude that "ancestral prenatal stress across generations cumulatively induced anxiety-like behaviors in F3 and F4 generation male offspring that were subjected to transgenerational stress or multiple repeated stress or multigenerational stress" (Ambeskovic et al., 2019, p. 3). Furthermore, they also state that "present findings support the notion that ancestral stress may program mental health outcomes via epigenetic regulation," as well as they highlight that

[3] Posttraumatic stress disorder.

"recent experimental and clinical studies have demonstrated that exposure to adverse environments early in life may propagate across generations to alter emotionality in unexposed offspring" (Ambeskovic et al., 2019, p. 6).

Thus, it seems that genes preserve some emotional "memory" of their past experiences, giving rise to a kind of contagion of the transgenerational collective subconscious that manifests its mark several generations later in the form of *ghost damage*.

Although these studies reopen the debate on determinism and causality in multifactorial phenomena, the fact that chromatin states can transmit a degree of heritable memory (Carlini et al., 2022) together with the existing literature on epigenetics and transgenerational transmission of trauma is enough to generate ethical questions on the nature of moral damage and its relationship to trauma, as well as transgenerational responsibility, as I will address in the next sections.

Conceptual implications: *ghost damage* as a new ethical tool

The notion of moral damage is always elusive. However, it can be understood —at least— as a wrong done between humans, "the human form of evil" (Thiebaut, 2005, p. 18), that is, the result of a morally relevant action or omission executed by a moral agent towards a moral patient, so that this action and the harm are judged as avoidable.

New advances in genetics show transgenerational[4] transmission of trauma and its effects at an epigenetic level in more than one generation, without the need for a narrative or conscious transmission of it. This gives rise to a specific moral damage, i.e., what I will call here *ghost damage* as a unified account to facilitate further ethical research.

Ghost damage refers to a type of moral damage characterized by the particularity that the victim experiences and suffers the consequences of something that has not happened to her as if it had happened to her, not as a psycho-somatization, but by the genetic imprint that the experience of previous generations has left on her. That is, the victim experiences the appearance of that damage without an executioner.

This type of damage would be as suffering an injury without having had an accident. It represents the appearance of the consequences of damage, without the previous experience of which —by definition— moral damage is a consequence. In this sense, the new findings on the transgenerational transmission of trauma at the epigenetic level involve challenges regarding moral damage both on a conceptual and normative sense, on which I will reflect throughout this article.

One might think that these cases do not differ from those already known about the intergenerational transmission of trauma and attachment styles of minors with their caregivers during early childhood (Widom et al., 2015). Evidence on the discontinuous transmission of trauma between generations in relation to parenting styles and relational trauma is also already well known (Hautamäki et al., 2010). However, although this discontinuity makes them more difficult to trace, they are always the result of the direct relationship between minors and their primary caregivers. The *ghost damages* that I address here differ from the damages that one can suffer in the first years of life before episodic memory develops, since, although the person does not remember what happened to her, these cases have a clear direct executioner, an identified triggering action that they did directly experience. Likewise, the previous generation, the primary caregiver with whom the minor interacts, knows what has happened. Thus, given that the victim suffers the consequences of a harm that she does not remember, but that has happened directly to her, this type of unconscious traces of harm differs from the idea of *ghost damage*. As a result, the concept of *ghost damage* may be useful to capture the specificity of those

[4] I will distinguish intergenerational from transgenerational, limiting the first term to cases where there is a relationship between members of different generations and the second term to cases where the following generations may not have had any interaction with the first.

transgenerational traumas transmitted through epigenetics, and to distinguish this phenomenon from other types of unconscious but first-person-experienced cases.

In this sense, it is important to distinguish early childhood experiences from the transgenerational transmission of trauma through epigenetics because it fractures and challenges the classic structure and relationship between agent/patient, action/omission and damage itself, which leads to paradoxical situations where there is a victim of the effect of a damage that she has never lived in her lifetime, unconsciously and unintentionally transmitted, which, in turn, also compromises the notion of moral responsibility.

In other words, the transgenerational transmission of the effects of an emotional trauma to generations that never interacted with the first nor received a legacy in the form of family narratives about the history of the first generation (the original trauma is unknown to the intermediate generations) gives rise to a phenomenon that breaks the structure of classic moral terms previously mentioned. In this sense, it fragments the classic nature of moral damage, where it is assumed that for X to be an instance of moral damage, X must be the result of a moral agent's action/omission on a moral patient. The paradoxical element about these cases is that the usual conditions evaporate in a certain sense: one experiences the consequences of a moral damage that one has not lived. This differs from having experienced something and not being able to remember it.

In the first case you are a victim of the consequences of a moral damage that you have not suffered, this being the characteristic that makes it hard to make sense of it. This is also different from intergenerational damage where a conscious traumatic experience is transmitted through family narratives, loyalties, etc. Here, even if it is second order or vicarious damage, the last generation sees herself as a victim of that inherited damage (for example, historical enemies) and is aware of the original experience.

Although damage during early childhood and damage resulting from the epigenetic transmission of trauma have in common the fact that they are unconscious for the victim, the difference is important. In those traumas transgenerationally transmitted through epigenetics, the victim has not lived anything related to that experience in her life, there is nothing to remember about her life. This is different from experiencing something firsthand during your lifetime and not being able to remember it. In these last cases, there is a clear agent who did something to you, the psychosomatic trace is more easily recoverable, there is indeed a clear action/omission and an own experience. The person has been a direct victim of something that she has experienced. In the transgenerational transmission of trauma (and moral damage) through epigenetics, you experience the consequence of a wound that you have never suffered. In unconscious or forgotten moral damages during early childhood, you carry the scar of a wound that was done to you, you are able to *see* the wound, but you do not remember how it was done to you. In *ghost damages* you do not *see* the wound (because it does not belong to you), but the effects. In this sense, early childhood traumas are consistent with what happened to you. In epigenetic transgenerational transmission of trauma, the imprint is not consistent with what happened to you in your lifetime, but with what happened to your great-grandparents, for instance. This distinction is also relevant in terms of treatment and help, since *ghost damage* may easily lead to forms of hermeneutical injustice harder to see and reverse, as I would develop in the following section. For all these reasons and nuances of the experience of moral damage, I suggest that this case requires a specific concept in order to capture its nature since otherwise key elements of this phenomenon would be overlooked.

Similarly, one might think that these cases refer to what we already know about the importance of moral damage resulting from omissions, and not only due to direct actions. Thanks to studies on emotional abandonment and complex post-traumatic stress in cases of dysfunctional parenting (Walker, 2013), the awareness on these cases has increased. In fact, chronic emotional neglect during childhood, based on omissions, generates overwhelming

feelings of shame, emptiness, fear, and, on many occasions, psychosomatic illnesses, which reflect the effects of what did not happen, that is, a childhood where basic emotional needs were not met. Certainly, the loneliness of feeling ignored during early childhood is as painful as a physical injury, even if it is not visible (Thompson & Kaplan, 1996), but this is not the type of damage captured by the concept of *ghost damage*. These intergenerational damages are the result of specific experiences that the victim lived, they are the result of actions and omissions done by her primary caregivers regarding their relationship with the child. Thus, the phenomenon raised by recent studies on the transgenerational transmission of the effects of trauma at an epigenetic level represents a qualitative leap compared to these psychological studies. In turn, this leads to ethical questions about the responsibility and visibility of moral damage.

The notion of *ghost damage* may entail a qualitatively distinct experience when compared to the challenges of the classical concept of moral damage linked to an agent and a patient. This concept may name a subtype of moral damage, different from the cases of invisible damages mentioned above, and experienced in the first person, but forgotten or normalized. For all this, especially considering how these studies modify the limits of the classic notion of damage, action, and omission, it seems necessary to count with a specific category, such a *ghost damage*, which helps address the ethical issues involved. The transgenerational trauma reflected in these studies can be interpreted as a way of "tracking" moral damage when a clear triggering event or causing agent are hard to identify in the present.

Likewise, one might think that the impact of environmental pollution and associated mutagenesis as well as the influence of rules impacting the environment where ancestors lived could be seen as other form of ghost damage. However, not every (epi)genetic mutation entails a case of (moral) *ghost damage*, while the concept of *ghost damage* refers to those instances of moral damage where there is an experience that was crystallized by the ancestors as emotionally traumatic and was unconsciously transgenerationally transmitted. In this sense, it is important to distinguish the impact of scientific and technological development in human genome from interpersonal trauma that may end up being objectivized[5] in the offspring.

Ghost damage refers to a subtype of moral damage related to interpersonal traumatic experiences with such an emotional impact on the victim that are transmitted up to four generations through epigenetics. This differs from environmental harm suffered by future generations, as the cause-effect line is not direct, but multifactorial and accumulative, and it is neither relational nor interpersonal. Rather, environmental damages imply synchronic (*prima facie*) morally neutral actions that result in aggregated damages related to collective responsibility, such as multiple hands damage, the tragedy of the commons, and, in Parfit's terms, the harmless torturer case. In this sense, it entails a different phenomenon in terms of moral damage that is not related to emotional interpersonal experiences, although also related to responsibilities to future generations.

In any case, as science evolves regarding the intergenerational and transgenerational transmission of trauma, perhaps the concept of *ghost damage* might be applied in the future to other phenomena that would entail some other sort of emotional injustice.

The existence of this type of *ghost damage* also supports the claim that defends the importance of placing the focus on the victim, and not on the agents' intentions, to identify invisible instances of injustice.

If the focus is placed on actions or intentions, *ghost damages* suffered by the following generations would go unnoticed, generating blind spots, since it would be difficult to justify that the person who originally caused the damage to the first generation also intended to harm

[5] Although the metaethical discussion surpasses the scope of this article, this crystallization of moral damage would also entail metaethical implications for the discussions between moral realism and subjectivism, since it represents an objectification of a subjective experience of moral damage.

the offspring. Thus, these studies could serve to support that an ethical perspective that revolves around the victim and the concept of damage could be more effective in avoiding the perpetuation of invisible damage. If the focus is placed on the impact, which is reflected in the victim without the need to identify the causative agent or his intentions, then these *ghost damages* become visible. Moreover, this would also help distinguish between the causative agent and the transmitter or enabler, a nuance that becomes crucial considering these transgenerational studies when it comes to attributing responsibilities, as I will develop in what follows.

Normative implications: new forms of responsibility and epistemic injustice

Contemporary moral philosophy has assumed a responsibility towards the past and the future. Nuances have been developed regarding the classic action/omission binomial, highlighting the weight of enabling moral damage. Likewise, contemporary ethics has reflected on responsibilities for collective damages including the intergenerational perspective (Spikerman, 2014).

Nevertheless, from the point of view of the causing agent, this type of damage leads to reconsider the scope of responsibility for our actions. Knowing that what we do has an impact, and is coded as damage, not only on the direct victims of our actions, but on the following generations, leads to open the debate on the demands of responsibilities, also diachronic. Considering the transgenerational transmission of trauma and moral damage, should the epigenetic imprint be interpreted as direct moral damage to future generations? Certainly, previous generations acquire here a double role as victims and enablers, since they contribute to the result, or at least as transmitters of unconscious damages, which, again, makes the demand for responsibilities more complex due to the paradoxical nature of the case.

Likewise, the implications in terms of public health are also concerning. If trauma has the power to emerge from the past and claim new direct victims in future generations affecting their psychological and physical health as shown in the first section, then the recognition and sometimes necessary assistance of those affected by this type of trauma is even more urgent, before the body can sabotage itself and subsequent generations. One should bear in mind that these victims also experience epistemic helplessness for not knowing where the symptoms come from, which constitute a second form of victimization. This alongside the plasticity and mutable nature of this legacy, if one is aware of it, make the responsibility of providing tools to reverse these effects more demandable.

Thus, from the point of view of the moral spectator and from a collective or social perspective, the existence of this type of damage may generate the duty, especially for mental health professionals, to update their knowledge regarding epigenetics studies to avoid epistemic injustice or double victimizations through the perpetuation of unexplainable symptoms.

Indeed, *ghost damage* may become an obvious source of epistemic injustice for the offspring, since, as a moral patient, one is not a simple recipient of past trauma. The person does not know that she does not know. This type of ignorance also generates a dissonance within the body: the body knows and shows something that the person does not know. That individual is not aware, nor has she directly experienced the event. This can leave the offspring in a helpless situation. Like someone who is sinking in a boat but does not detect the crack through which the water is seeping, this type of damage would be like having an illness without a cause if the person does not know about the traumatic experience of her ancestor. This may generate instances of hermeneutical injustice since the symptoms that the descendants experience are not consistent with their biography. This, in turn, jeopardizes the due recognition, which may generate double victimizations, since that person is in a position of epistemic disadvantage, with the consequent toll on their social position.

In other words, knowing that the stress associated with early adversity could affect future generations, regardless of the life experience of those generations (Meaney, 2010) and not acting accordingly, making this knowledge explicit, may put the following generations at a particularly vulnerable situation, as they become patients of the consequences of a damage that they are unaware.

This gives rise to a subtype of hermeneutical injustice, in M. Fricker's (2007) terms, and, specifically, to a kind of emotional injustice, where the lack of information about their family history crystallizes in a situation that truncates not only their present well-being, but their ability to repair that *ghost damage*.

Thus, the *ghost damages* derived from this epigenetic legacy could easily generate in the offspring what K. Dotson calls epistemic smothering (2011), a concept that is even more illustrative and fits with Fricker's notion of epistemic darkness, understood as a space whose air is disturbed. If this responsibility towards the victims is ignored as a matter of public health, collective silencing would mean an elimination of the common space, that is, a "hermeneutical death" (Broncano, 2020, p. 255). As a result, and in relation to collective responsibilities, these studies may lead us to a debate on a right to know family history to materialize the right to mental and physical health and to avoid the hermeneutical darkness or epistemic smothering that *ghost damages* may entail for the offspring, since it manifests itself as a kind of unconscious transgenerational memory.

Recognizing such a right to information may imply clear social and bioethical consequences. It would imply the need to recognize a right to access the basic biography of your ancestors up to four generations and would have direct implications in the treatment of cases such as adoption, anonymous donation of genetic and reproductive material, as well as surrogacy motherhood. Without going into the rest of the bioethical aspects of each of these cases here, as that would surpass the scope of this article, the existence of a transgenerational emotional memory and the expression of its impact on the descendants inevitably lead to reopen a debate on the children's right to know their origins in cases of anonymous donors of reproductive material. As personal identity and past psycho-medical history are distinguishable, one could maintain the anonymity of the donors while providing the child with the information about the most significant psycho-socio-biographical events of previous generations. This would serve to avoid epistemic neglect.

On the one hand, it is still questionable to what extent the disclosure of this information would not lead to the identification of the donors. On the other hand, not taking this epigenetic information into account could result in epistemic negligence towards future generations and, specifically, in emotional injustice, since we would be perpetuating the effects of a past trauma and jeopardizing the possibility to know the origin of their symptoms and, in turn, to repair that inherited damage. Thus, these epigenetic studies entail a debate that should not be overlooked between reproductive rights and the right to identity of adopted children and those where an anonymous donation of genetic material is involved. Currently, the disclosure of anonymous donors' identity is only allowed in extremely specific cases and contexts where physical health is involved, such as the Johnson *vs* the Superior Court case given the 276-donor's health issues.[6] These cases have not led to the development of a right to identity, a right already present in other types of affiliations, such as adoption. However, in the following years the existence of *ghost damages* may extend this right to a larger group of population as a necessary means to avoid the perpetuation of the effects of trauma and inexplicable symptoms. Thus, this may give rise to new nuances on how to implement the right to know one's origins and identity, given that, although the epigenetic legacy is plastic and changeable, one may not be able to change what she is not aware of.

[6] See https://law.justia.com/cases/california/court-of-appeal/4th/80/1050.html

Therefore, at the individual level, *ghost damage* may lead to reevaluate the tension between parental autonomy and children's rights, since knowing that the offspring's development and health can suffer the profound influence of previous generations' traumatic experiences, surely generates new unavoidable intergenerational responsibilities.

Conclusion

Throughout this article I have presented the results of the most notable studies on transgenerational transmission of trauma through non-genomic mechanisms, i.e., epigenetics. I have shown the emotional impact of adverse experiences and how these can induce metabolic and psychiatric, cognitive, and emotional disorders throughout the following generations, which gives rise to a new type of moral damage.

Considering these studies, I have defended how these advances entail a challenge to classic moral concepts such as moral damage and its relationship to the agent/patient, and action/omission. Thus, I have suggested the concept of *ghost damage* to name a blurred reality that, otherwise, would remain invisible since this type of damage manifests itself without a direct agent, without a witness, without having lived the experience that would generate it, and without being aware of it. Proposing a specific concept for this type of transgenerational damage may surely contribute to its visibility, recognition, and repair. In this line, I have addressed the ethical challenges and consequences of these studies in normative terms defending the benefit of implementing an approach on responsibility centered on the victim to avoid the perpetuation of invisible instances of moral damage. Thus, if intergenerational responsibilities are taken seriously in a synchronic and diachronic sense, these findings may urge us to expand the concept of moral damage to include those *ghost damages*. By doing so, double victimizations, hermeneutical injustice, epistemic neglect, emotional injustice, and some sort of moral blindness could be avoided in many cases. Likewise, the existence of the transgenerational transmission of trauma through epigenetics may lead to expand the moral weight of omissions, and to question the role of enablers, which is the role of intermediate generations.

Without falling into moral perfectionism and without the need to violate the right to privacy, I conclude by suggesting the defense of the right to information and the diagnosis, prevention, and treatment of trauma as key points to materialize the right to physical and mental health. These elements constitute key factors to avoid compromising the physical and mental health of future generations as well as the perpetuation of inherited moral damage.

By raising these implications and open questions, I hope to have contributed through suggestions to the (bio)ethical discussion on epigenetics, which will undoubtedly continue to develop in the coming decades.

References

AMBESKOVIC, M., BABENKO, O., ILNYTSKYY, Y., KOVALCHUK, I., KOLB, B. & METZ, G. A. (2019): Ancestral stress alters lifetime mental health trajectories and cortical neuromorphology via epigenetic regulation. In: *Scientific Reports*, 9(1), p. 6389.

BARKER, E. D., WALTON, E. & CECIL, C. (2018): DNA methylation as a mediator in the association between risk exposure and child and adolescent psychopathology. In: *Journal of Child Psychology and Psychiatry,* 59, pp. 303–322.

BENDER, A. (2015): Suicide sweeping Indian Country is genocide. In: *People's world* [online] [Retrieved January 23, 2024] Available at: https://www.peoplesworld.org/article/suicide-sweeping-indian-country-is-genocide/

BOHACEK, J. & MANSUY, I. M. (2015): Molecular insights into transgenerational non-genetic inheritance of acquired behaviours. In: *Nature Reviews Genetics*, 16(11), pp. 641–652.

BRANJE, S., GEERAERTS, S., de ZEEUW, E. L., OERLEMANS, A. M., KOOPMAN-VERHOEFF, M. E., SCHULZ, S., ... & BOOMSMA, D. I. (2020): Intergenerational transmission: Theoretical and methodological issues and an introduction to four Dutch cohorts. In: *Developmental Cognitive Neuroscience*, 45(4), p. 100835.
BRONCANO, F. (2020): *Conocimiento expropiado. Epistemología política en una democracia radical* [*Expropriated knowledge. Political epistemology in a radical democracy*]. Madrid: Akal.
CARLINI, V., POLICARPI, C. & HACKETT, J. A. (2022): Epigenetic inheritance is gated by naïve pluripotency and Dppa2. In: *The EMBO Journal*, 41(7), p. e108677.
DIAS, B., & RESSLER, K (2013): Parental olfactory experience influences behavior and neural structure in subsequent generations. In: *Nature Neuroscience*, 17, pp. 89–96.
DOTSON, K. (2011): Tracking epistemic violence, tracking practices of silencing. In: *Hypatia*, 26(2), pp. 236–257.
FENNELL, K. A., BUSBY, R. G. G., LI, S., BODDEN, C., STANGER, S. J., NIXON, B., ... & PANG, T. Y. (2020): Limitations to intergenerational inheritance: subchronic paternal stress preconception does not influence offspring anxiety. In: *Scientific reports*, 10(1), p. 16050.
FRICKER, M. (2007): *Epistemic injustice: Power and the ethics of knowing*. Oxford: Oxford University Press.
GAPP, K., BOHACEK, J., GROSSMANN, J., BRUNNER, A. M., ... & MANSUY, I. M. (2016): Potential of environmental enrichment to prevent transgenerational effects of paternal trauma. In: *Neuropsychopharmacology*, 41(11), pp. 2749–2758.
GAPP, K. & FRANKLIN, T. (2021): *Transgenerational epigenetics and psychiatric disorders*. In: J. Peedicayil, D. R. Grayson & D. Avramopoulos (eds.): *Epigenetics in Psychiatry*. Cambridge: Academic Press, pp. 761–782.
GAPP, K., JAWAID, A., SARKIES, P., BOHACEK, J., PELCZAR, P. & PRADOS, J. (2014a): Implication of sperm RNAs in transgenerational inheritance of the effects of early trauma in mice. In: *Nature Neuroscience*, 17, pp. 667–669.
GAPP, K., SOLDADO-MAGRANER, S., ALVAREZ-SÁNCHEZ, M., BOHACEK, J., VERNAZ, G., SHU, H., ... & MANSUY, I. M. (2014b): Early life stress in fathers improves behavioural flexibility in their offspring. In: *Nature communications*, 5(1), p. 5466.
GAPP, K., van STEENWYK, G., GERMAIN, P. L., MATSUSHIMA, W., RUDOLPH, K. L., MANUELLA, F., ... & MISKA, E. A. (2020): Alterations in sperm long RNA contribute to the epigenetic inheritance of the effects of postnatal trauma. In: *Molecular Psychiatry*, 25(9), pp. 2162–2174.
GEDDES, L. (2013): Fear of a smell can be passed down several generations. In: *New scientist*, 220(2946), p. 10.
HAUTAMÄKI, A., HAUTAMÄKI, L., NEUVONEN, L. & MALINIEMI-PIISPANEN, S. (2010): Transmission of attachment across three generations: Continuity and reversal. *Clinical Child Psychology and Psychiatry*, 15(3), pp. 347–354.
IMMLER, S. (2018): The sperm factor: paternal impact beyond genes. In: *Heredity*, 121(3), pp. 239–247.
LEHRNER, A., BIERER, L. M., PASSARELLI, V., PRATCHETT L. C., FLORY, J. D., BADER, H. N., HARRIS, I. R., BEDI, A., DASKALAKIS, N. P., MAKOTKINE, I. & YEHUDA, R. (2014): Maternal PTSD associates with greater glucocorticoid sensitivity in offspring of Holocaust survivors. In: *Psychoneuroendocrinology*, 40, pp. 213–220.
LEWIS, T. (2013): Fearful experiences passed on in mouses families, *Live science*, [online] [Retrieved 23 January, 2024] Available at: https://www.livescience.com/41717-mice-inherit-fear-scents-genes.html
MEANEY, M. J. (2010): Epigenetics and the biological definition of gene X environment interactions. In: *Child Development*, 81, pp. 41–79.

MEANEY, M. J. & SZYF, M. (2005): Maternal care as a model for experience-dependent chromatin plasticity? In: *Trends in neurosciences*, 28(9), pp. 456-463.
PEMBER, M. A. (2015): Trauma may be woven into DNA of Native Americans. In: *Indian Country Today Media Network*, 20.
RODRÍGUEZ, T. (2015): Descendants of Holocaust survivors have altered stress hormones. In: *Scientific American Mind*, 26(2), p. 10.
ROTH, M., NEUNER, F. & ELBERT, T. (2014): Transgenerational consequences of PTSD: risk factors for the mental health of children whose mothers have been exposed to the Rwandan genocide. In: *International journal of mental health systems*, 8, pp.1–12.
SPIEKERMANN, K. (2014): Small Impacts and Imperceptible Effects: Causing Harm with Others. In: *Midwest Studies in Philosophy*, 38(1), pp. 75–90.
THIEBAUT, C. (2005): "Mal, daño y justicia" ["Evil, damage, and justice"]. In: *Azafea. Revista de filosofía*,7, pp. 15–46.
THOMPSON, A. E. & KAPLAN, C. A. (1996): Childhood Emotional Abuse. In: *The British Journal of Psychiatry*, 168(2), pp. 143–148.
VENDRAMINI, D. (2005): Noncoding DNA and the teem theory of inheritance, emotions and innate behaviour. In: *Medical Hypotheses,* 64, pp. 512–519.
WALKER, P. (2013): *Complex PTSD: From surviving to thriving.* California: Azure Coyote.
WIDOM, C. S., CZAJA, S. J. & DUMONT, K. A. (2015): Intergenerational transmission of child abuse and neglect: Real or detection bias? In: *Science*, 347(6229), pp. 1480–1485.
YEHUDA, R., BIERER, L. M., SCHMEIDLER, J., AFERIAT, D. H., BRESLAU, I. & DOLAN, S. (2000): Low cortisol and risk for PTSD in adult offspring of holocaust survivors. In: *American Journal of Psychiatry*, 157(8), pp. 1252–1259.
YEHUDA, R., DASKALAKIS, N. P., LEHRNER, A., DESARNAUD, F., BADER, H. N., MAKOTKINE, I., ... & MEANEY, M. J. (2014): Influences of maternal and paternal PTSD on epigenetic regulation of the glucocorticoid receptor gene in Holocaust survivor offspring. In: *American Journal of Psychiatry*, 171(8), pp. 872–880.
YEHUDA, R., DASKALAKIS, N. P., BIERER, L. M., BADER, H. N., KLENGEL, T., HOLSBOER, F. & BINDER, E. B. (2016): Holocaust exposure induced intergenerational effects on FKBP5 methylation. In: *Biological psychiatry*, 80(5), pp. 372–380.
ZHENG, X., LI, Z., WANG, G., WANG, H., ZHOU, Y., ZHAO, X., ... & SUN, F. (2021): Sperm epigenetic alterations contribute to inter-and transgenerational effects of paternal exposure to long-term psychological stress via evading offspring embryonic reprogramming. In: *Cell Discovery*, 7(1), pp. 101–123.