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Epigenetics as an interdiscipline? Promises and fallacies of a biosocial research agenda

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Abstract

Following the spectacular rise of epigenetics since the early 2000s, an increasing number of social scientists have called for it to be recognized as an ‘interdiscipline’, at the crossroads of the life sciences and the social sciences. The aim of this special issue is to advance our knowledge of epigenetics and to address three main issues: the epistemological, conceptual and empirical transformations induced by epigenetic research, the public dissemination of epigenetic knowledge, and finally the normative and sociopolitical implications of epigenetics.

Keywords

biodata, biosocial, epigenetics, interdisciplinarity, science studies

Résumé

Suite à l’essor spectaculaire de l’épigénétique depuis le début des

années 2000, un nombre croissant de chercheurs en sciences sociales demandent à ce qu'elle soit reconnue comme une 'interdiscipline', au carrefour des sciences de la vie et des sciences sociales. Ce numéro spécial a pour but de faire progresser notre connaissance de l'épigénétique et d'aborder trois questions principales : les transformations épistémologiques, conceptuelles et empiriques induites par la recherche épigénétique, la diffusion publique des connaissances épigénétiques, et enfin les implications normatives et sociopolitiques de l'épigénétique.

Mots-clés

biodata, biosocial, épigénétique, étude des sciences, interdisciplinarité

Following the spectacular rise of epigenetics since the early 2000s, an increasing number of social scientists have called for it to be recognized as an 'interdiscipline', at the cross-roads of the life sciences and the social sciences. Central to their claim is the integration of social variables such as environmental exposure, nutritional habits, stress and prejudice, extreme adversity or stigma into the life sciences. This integration may in turn prompt the social scientists to alter their established ways of thinking about biology so as to actively contribute to the formation of emerging 'biosocial' research frameworks that could explore the entanglement between biological, environmental, and social aspects of life (Dubois, Guaspere & Louvel, 2018). Engagement through inter or transdisciplinarity seems as much a prerequisite for the development of a biosocial research agenda, as a secured source of funding opportunities: 'In an era of declining budgets for social science research, funding councils will look favorably on work that intersects with biology [. . .] because it will promise the kind of scientific credibility that governments periodically suggest the social sciences lack' (Meloni, Williams & Martin, 2016: 164). Despite institutional support from national and international agencies or institutes – notably the grant program *Social Epigenomics Research in Health Disparities* put out by the National Institutes of Health (NIH) in 2017 and 2019 – and a few recent editorial initiatives (*New Genetics and Society*, 2015; *BioSocieties*, 2018), many epistemological, economic, social and political issues in epigenetics remain to be investigated (Heil et al., 2017). What

could be the substance of epigenetics as an 'interdiscipline' (Frickel, 2004) in which social scientists and life scientists coproduce innovative research programs? Beyond the usual promissory scientific discourses, does epigenetics really unsettle the disciplinary boundaries between the social sciences and the life sciences that date back to the end of the 19th century? Or, in a more limited way, does it contribute to renewing their methods and objects? What type of epigenetic data may be of interest to social scientists? Does the prospect of informing public policy of the role of epigenetics in human diseases point to new perspectives in public health? Can the potential transmission of epigenetic marks between generations support the mobilization of social groups and their claims relating to the experience of former generations? The aim of this special issue is to advance our knowledge of epigenetics and to address the multiple consequences of this area of research for the social sciences. As acknowledged by most commentators, 'epigenetics' means literally what is 'above' or 'beyond' genetics. And as it will rapidly become clear to the reader, the exact nature of epigenetics and its relationship to genetics are still widely debated in the scientific community. The seven articles gathered for this special issue problematize the still uncertain nature of epigenetics from different disciplinary points of view: Law and Ethics (Dupras, Joly & Rial-Sebbag), History and Political Science (Grossi), Linguistics, Media and Cultural studies (Nerlich, Stelmach & Ennis), Sociology of Science and Technology (Dubois & Guaspare; Louvel; Pinel) or Scientometrics (Larregue, Larivière and Mongeon). Regardless of their particularities, these articles broadly address three main issues: (1) the epistemological, conceptual and empirical transformations induced by epigenetic research; (2) the public dissemination of epigenetic knowledge; (3) and finally the normative and sociopolitical implications of epigenetics.

Transforming science

Four out of the seven articles question the nature of the organizational and epistemic transformations induced by epigenetics (articles by Dubois & Guaspare, Larregue et al., Louvel and Pinel). They provide original and empirical insights to question at least two commonplaces about epigenetics: it constitutes a scientific revolution; it massively displaces disciplinary demarcations between the life sciences and the social sciences.

Up till now, epigenetics has not constituted a ‘revolutionary’ break with the past, despite a commonly held idea that has been bandied about to ‘sell’ it. On the contrary, the articles in this special issue highlight the fact that epigenetics remains strongly embedded in well-established organizations, communities and networks. First, several articles emphasize the close links between genetics and epigenetics. For Larregue, Larivière and Mongeon the continuity is strong at the institutional level: prominent figures in epigenetics have been trained in molecular genetics; the North American and European genetics departments are nerve centers of epigenetic research. But the articles in this issue also highlight continuity in terms of concepts and tools. Dubois and Guaspare, as well as Louvel recall that studying epigenetic mechanisms through which social environments become embedded requires the genes to be located – or the portions of the genes – on which epigenetic modifications take place. Therefore, social epigenetics is based on prior studies of gene expression and function and depends closely on the dominant methods of genetics. Most of the social epigenetic studies adopt the so-called ‘candidate gene’ approach, where a gene is selected for study, based on a priori knowledge of its biological function.

Then, the articles trace the multiple scientific filiations of epigenetics, without which its so called ‘revolutionary’ advances would not be possible. Three articles make use of bibliometrics to describe how epigenetics relates to several research areas. Larregue, Larivière and Mongeon point out that research in epigenetics is developing mainly in cancer biology, molecular biology and biochemistry, as well as in developmental biology. Louvel claims that research in social epigenetics develops from several epistemic backgrounds in the neurosciences, psychiatry, behavioral sciences, developmental psychology, endocrinology and epidemiology. Dubois and Guaspare point out that the social epigenetics of historical trauma builds on the work done in the 1980s on the psychobiology of traumatic exposure, or the biological psychiatrics of mental disorders, such as Post Traumatic Stress Disorder (PTSD) and childhood trauma. The social epigenetics of historical trauma recombines several preexisting approaches in an innovative way.

Finally, Pinel’s article presents epigenetic research as a particularly striking example of ‘Big Biology’, where massive data is collected

under the assumption that ‘more data means better results’ and infrastructures are established to acquire, process and share these data. Pinel studies ‘epigenomics’ – the study of all epigenetic marks at the genome level. Like the ‘omics’ that have been developing since the 1990s (genomics, proteomics, transcriptomics), epigenomics is based on large-scale research collaborations as national and international consortia have been created to collect new data, share existing data, conduct meta-analyses or standardize methods. Pinel’s article provides a detailed analysis of how laboratories share research and clinical data produced in epigenomic research. She argues in particular that the production of valuable knowledge from data-intensive research ‘does not simply originate from an abundance of data’. Data curation and processing requires considerable invisible work which can also be observed in adjacent research areas such as gene expression or genomics.

Social scientists have nurtured the hope that epigenetics will open up ‘sociological- cum-biological research programs’ (Meloni, 2014) and that it will become an interdisciplinary field at the interface between biological and social sciences. Articles in this special issue contribute to moderate these high expectations. Larregue, Larivière and Mongeon remind social scientists of the ‘inconvenient fact’ that only environmental epigenetics and social epigenetics are conducive to interdisciplinary experiments with social sciences, and both remain for the moment marginal within the general epigenetic landscape. While Larregue, Larivière and Mongeon identify 199,484 publications in epigenetics (between 1991 and 2017), Louvel identifies only 1,933 articles in social epigenetics, published between 2000 and 2018. She also mentions that about 100 articles in social epigenetics are published in ethics, social science and social work journals. This could indicate burgeoning interdisciplinary collaboration with the natural sciences. However, Louvel points out that most of these articles offer a critique of social epigenetics, either simply rejecting it, or warning against its possible misuses.

Finally, at this stage, one should keep in mind that most of the existing ‘social study of epigenetics’ work is *on* epigenetics rather than *with* epigenetics (Dubois, Guaspare & Louvel, 2018). This is a far cry from the interdisciplinary ‘co-laboration’ that anthropologist Jorg Niewöhner called for (Niewöhner, 2015). However, the articles in this special issue also describe the early and still limited ‘biosocial’, ‘psychobiosocial’ or ‘biocultural’ experiments that are

currently taking place within social epigenetics. Dubois and Guaspere report on collaborations between geneticists and anthropologists studying the transgenerational effects of the successive wars in the Congo. Louvel draws attention to studies in social epigenetics in which scholars in the sociology of education, family, health, or crime, work with psychologists, psychiatrists and biologists. The author argues that although these interdisciplinary research publications are limited in number, they nevertheless enrich 'biosocial' approaches to social and health inequalities in two ways: they provide the biological sciences with more relevant indicators of social adversity over the course of life; and they propose that the social sciences use a new biomarker, the 'epigenetic clock', to 'link social processes to the physiological workings of our bodies and minds' (Timmermans & Haas, 2008).

Disseminating knowledge

This special issue is also an opportunity to analyze how scientific knowledge circulates beyond the scientific community. Three contributions turn the public circulation of epigenetics into an object of empirical investigation (articles by Nerlich, Stelmach & Ennis; Dubois & Guaspere; Grossi). These articles share the same general starting point: compared to other emerging areas of research, epigenetics has a high public profile. The development of epigenetics since the early 2000s has benefited from a constantly growing media coverage: from the famous front cover of *Time Magazine* – 'Why your DNA isn't your destiny' – to the recurring science columns of *The New York Times*, *The Guardian* or *Le Monde*. Even though epigenetics as science remains highly complex and the details of epigenetic mechanisms are vividly debated within the scientific community, for various reasons epigenetics attracts the attention of the general public and is frequently enrolled to develop new markets or to support various claims (Dubois et al., 2019).

The contributions adopt a qualitative approach based on samples extracted from the science sections of established newspapers, blogs and various social media. Nerlich, Stelmach and Ennis, for example, combine a long-term observation of online activities, with the detailed analysis of 70 tweets. Grossi reviews a collection of articles and blogs affiliated to social movements (Black Lives Matter) or related to African-American culture and identities (*Grandmother Africa*, etc.). Dubois and Guaspere analyze nearly 250 items (press articles, blog posts, interviews, reports, etc.)

belonging to three different public ‘circles’, at a greater or lesser distance from the scientific community. The analysis of these items shows that the public discourse remains dependent on the knowledge produced by the scientific community. Most of the time, public discourse is ‘inspired’ by the work of science popularizers or ‘visible scientists’ who are frequently aware of the social resonance of their work. It would of course be too naive to assume that scientists ignore everything about the public circulation of the knowledge they produce. But still the public discourse cannot be reduced to simple popularization. There are specific dimensions to this discourse that need to be studied in themselves. As Nerlich, Stelmach and Ennis explain, quoting Farr: ‘Once a scientific theory enters the public arena it acquires a life of its own.’ Among those elements of public communication that deserve special attention, Nerlich, Stelmach and Ennis focus on the importance of ‘metaphors’ and ‘commonplaces’: ‘Commonplaces shape understanding of the world and of what counts as ‘common sense’ in public understanding of science’. Frequently, epigenetics is publicly depicted as a ‘new’ science demonstrating that genes can be ‘switched on and off’. This central ‘switch’ metaphor pervades a majority of popular descriptions of epigenetics. Moreover a detailed analysis of commercial communication made on Twitter shows that advertisers trying to sell their products (epigenetic creams, cookbooks, fitness plans, coaching services, etc.) make the issue of control a powerful commonplace to obtain and keep the attention of the general public: ‘You can control your genes through epigenetics – and not only that, through your mind.’ This comes across very well in a tweet which defines epigenetics as ‘the power of consciousness’. An increasingly important part of the public appropriation of epigenetics revolves around the ability of certain private actors to sell an illusion of control over oneself and one’s body through various products and services.

The articles by Dubois, Guaspare and Grossi both emphasize the importance of the process of extrapolation. Social epigenetics became known to the general public in part because of the spectacular nature of two historical case studies: the famous Dutch Hunger Winter and the Holocaust. As observed by Grossi, even though Rachel Yehuda, a professor of Psychiatry and Neuroscience at the Icahn School of Medicine, Mount Sinai, has never worked on race and slavery in the United States, her articles on the

biological imprint of the Holocaust are frequently referenced on blogs and in newspaper articles to discuss slavery. Dubois and Guaspare claim that: 'The public circulation of epigenetics is [partly] based on the "actors" ability to create a "family resemblance" between two distinct situations, with varying degrees of similarity, and to try to extrapolate what they think they know about one to apply it to the other. [. . .] The public "truths" of social epigenetics are used as resources to discern or anticipate new possible cases, sometimes as a direct reaction to current news. In the United States, for example, the situation of illegal migrants was rapidly reconstructed in the public debate as a potential "case" for the social epigenetics of trauma'.

Although there is no need to detail the various mechanisms associated with the dissemination of epigenetics, two general topics of discussion should be briefly mentioned. The first refers to the need for life scientists to rethink the modalities by which they communicate publicly. For more than a century, genetics has contributed to shape and spread a basic understanding of heredity and genetic predispositions and has striven to influence its social and political uses. Epigenetics contributes today to a more or less profound destabilization of this pre-existing interpretative repertoire, but it is not always easy for the general public to understand the exact nature of this transformation. And, very often, the public discourse remains confused about the nature of the relationship between genetics and epigenetics. While commentators frequently point out, with varying degrees of irony, the distorting effects associated to the public diffusion of epigenetics, it seems, as emphasized by Dubois and Guaspare, more fruitful to reflect collectively on the various ways to anticipate and correct these distorting effects: 'This touches on the genuine difficulty, for those who participate in publicizing [. . .] epigenetic research, to communicate the nuances and complexities of this research approach'.

A second topic that emerges from these articles concerns not so much the life scientists as the social scientists. Dubois and Guaspare argue that the academic integration of epigenetics by social scientists, like the public discourse, vehicules a too simplistic representation of the relation between genetics and epigenetics. The framing adopted by social scientists 'opposes genetics and epigenetics, and, more specifically, the social uses which are inherently "discriminatory" and/or "essentializing" of the former

and those which are supposedly “emancipatory” and/or “transformative” of the latter. This framing is, in reality, too reductive for understanding the social and political malleability of genetics and epigenetics’. In order for the social sciences to develop genuine interdisciplinary collaborations, it seems indispensable to abandon this binary framework. More worryingly, Nerlich, Stelmach and Ennis show that the social scientists’ discourse can sometimes hardly be differentiated from the discourse produced by online advertisers. Of course, the former has its own metaphors, boundaries and barriers, but still it shares with the latter a whole set of commonplaces and metaphors: ‘Both academics and advertisers share a metaphorical framing and reframing of the gene and genome from a so-called fixed entity to a dynamic, flexible and plastic one. Both position traditional biology as “gene-centric” and want to replace it with a “social” gene or genome “reprogrammable” by epigenetics. Both hanker after “genoplasticity”. Both speculate about being able to address social and psychological ills such as trauma brought about by violence, colonial-ism or social injustice.’ While this cultural and linguistic proximity does not in itself raise any critical issues for the public, one may wonder what consequences it could have on the robustness of the knowledge produced by the social sciences trying to develop new interdisciplinary collaborations.

Norms and sociopolitical uses

Finally, a third set of articles analyzes how epigenetic knowledge spreads into social norms, affects sociopolitical behaviors, and may be used in legal contexts. The contributions by Dubois and Guaspare, Grossi, Dupras, Joly and Rial-Sebbag question, using various disciplinary approaches, how the scientific and public discourse on epigenetics has been used for sociopolitical ends. The articles, thus, first survey the weight of genetics on the production of norms related to epigenetics, and then examine the role of epigenetics in social and legal claims.

The articles underline that social scientists, policy-makers and law scholars have, historically, drawn a parallel between the social, ethical and legal questions arising from genetics and epigenetics (Rothstein, Cai & Marchant, 2009; Rial-Sebbag et al., 2016). From the legal point of view, various norms were already in place for genetics at international, European and national levels. Furthermore, several social science scholars tend to think that ‘epigenetics does

not seem to present this much-anticipated break between genetic determinism and bio-social malleability' (Grossi in this issue) and that, in particular, it 'repackages' previous biological concepts of heredity and race. However, the authors in this special issue claim that, despite the strong continuity between genetics and epigenetics, the latter might have specific social, legal and political implications. Following on from this, Grossi discusses how epigenetics redefines concepts of 'soft-heredity' and ideas of biological plasticity in ways that do not totally rule out 'genetic fixity' and 'genetic determinism', but which change understandings of issues such as ethnic health disparities and racial discrimination. Furthermore, she shows how the debate between genetic fixity and biological plasticity may enter 'the public arena' through the adoption of two resolutions (ACR8 and ACR 177) by the California State Assembly. These Resolutions, particularly ACR 177, aimed at 'raising public awareness of transgenerational trauma and the role that epigenetic research plays in understanding this trauma suffered by "communities of colors"'. Thus, Grossi highlights that these Resolutions 'bring legitimacy to racial epigenetics in the public discourse by publicizing it, while using epigenetics to legitimate claims about minority injustice'. In the same vein, Dubois and Guaspare discuss several examples where the intergenerational transmission of trauma has been publicized first by public discourse on gene transmission then gained broader circulation with 'social epigenetics'. They insist on the willingness of various social and political actors to engage with the scientific literature, with the overall objective of influencing norms and policy guidelines, such as those produced in France by the Parliamentary Office on the Evaluation of Scientific and Technological Choices (OPECST). Finally, the article from Dupras, Joly and Rial-Sebbag, investigates how epigenetics questions the existing normative frameworks related to genetics, and what should be the best governance for epigenetic information in the future. To embrace the future applications of epigenetics, they insist on the relevance of using the Human Rights framework. They, thus, propose 'to assess whether existing normative frameworks provide adequate ethical and legal guidance for the responsible conduct of epigenetics research and translation of findings into both medical and non-medical applications'. They address 'two perspectives: first, the normative guidance currently provided for epigenetics by human

rights law; and second, the potential epistemological impact of epigenetics on conceptual foundations underpinning human rights and bioethics declarations'. As demonstrated by these authors, epigenetics is linked to heritage and transmission. Thus, surveying the potential transmission of epigenetic marks to future generations implies interrogating possible claims and responsibility. Three contributions (Dubois & Guaspare; Grossi; Dupras, Joly & Rial-Sebbag) argue that epigenetics may be used to forge new social claims and new forms of responsibilities. It has been several times argued that mothers could 'be blamed for exposing their children to epigenetic disruptors' (Dupras, Joly & Rial-Sebbag). As also underlined by Dubois and Guaspare, as well as Grossi, individuals or groups sharing the same characteristics are at risk of stigmatization and discrimination. Their legal liability may also be engaged in courts. Even though responsibility can be attributed at an individual level, epigenetics could also serve as a basis to launch collective actions or to make political claims. Consequently, Grossi analyses the concept of 'reparation' and how it has been used to claim the recognition of a victim status based on a 'biological proof', through an examination of activists' blog posts. In other words, she shows that bloggers use epigenetics as a powerful rhetorical tool to describe the transmission of trauma (slavery), thus illustrating a process of 'strategic racialization'. Dubois and Guaspare discuss four sociopolitical repertoires – 'collective recognition of the unique nature of a condition that is both social and biological', 'collective reparation', 'call for public action', 'new health-care culture' – that could be actionable for actors to get their prejudice recognized or compensated. These results illustrate the necessity to go beyond individual responsibility, and to further elaborate legal or normative frameworks to sustain individual or collective claims for reparation. This is the idea developed by Dupras, Joly & Rial-Sebbag when they propose to 're-value the socio-cultural heritage of humanity'. They argue that 'environmental and social epigenetics should contribute to a renewed appreciation of the socio-cultural heritage of humanity, and support the promotion of economic, social and cultural rights such as the right to employment and decent working conditions, right to housing and social security, as well as solidarity rights, such as the right to natural resources and a healthy environment, and the right to intergenerational equity and sustainability'. More generally, they demonstrate through the analysis of various legal

instruments adopted in the Human Rights era how inappropriate or limited conventional individual rights such as property or privacy are, and how relevant a framework based on solidarity could be. They thus propose a set of provisions, from existing declarations, that could sustain collective and individual claims based on the principal of a 'just reparation' and that could be extended to epigenetic prejudice. Finally, they propose a better and more relevant instrument to properly address issues raised by epigenetics: the *Universal Declaration of Humankind Rights* (DHK, 2015) which was proposed during the COP21 but has not been adopted yet. This Declaration 'is a milestone in the proposal of a "new generation of rights"' (Le Bris, 2017). They conclude that 'even though epigenetics is not referred to explicitly in the document, this proposal could serve as a basis to guide the responsible conduct of research in this field'.

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