



Review article

After geneticization

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ARTICLE INFO

Article history:

Received 2 November 2015

Received in revised form

4 May 2016

Accepted 5 May 2016

Available online 7 May 2016

Key words:

Geneticization

Medicalization

Constructionism

Assemblage

ABSTRACT

The concept of geneticization belongs to a style of thinking within the social sciences that refers to wide-ranging processes and consequences of genetic knowledge. Lippman's original use of the term was political, anticipating the onerous consequences of genetic reductionism and determinism, while more recent engagements emphasise the productivity and heterogeneity of genetic concepts, practices and technologies. This paper reconstructs the geneticization concept, tracing it back to early political critiques of medicine. The argument is made that geneticization belongs to a style of constructionist thinking that obscures and exaggerates the essentializing effects of genetic knowledge. Following Hacking's advice, we need a more literal sense of construction in terms of 'assembly' to give a clearer account of the relationship between processes and products. Using the 'assemblage' concept to explore the social ontology of genetics, the paper reviews three areas of the empirical literature on geneticization – disease classification, clinical practice and biosociality – to show that a new style of thinking has appeared within the social sciences. In the final assessment, the conditions that gave rise to geneticization are now obsolete. While it may serve as a useful ritual of debate, conceptually geneticization offers a limited account of the heterogeneity of socio-technical change.

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1. Introduction

Since the early 1990's, the concept of 'geneticization' has become a watchword among critical commentators concerned with the increasing application of genetic medicine. Like 'ization' words more generally, it belongs to a style of thinking within the social sciences that refers to wide-ranging processes and consequences. Such words have been the bread and butter of sociology because they awaken the imagination and disrupt the naturalness of social order. The more shocking the change, the more we take notice. Geneticization has excellent shock value because it anticipates the potentially negative political consequences of genetic reductionism and determinism.

Perhaps we can treat geneticization as a symptom of how the social sciences think about biological science, and how this style of thinking has changed. In the last couple of decades, social scientists have questioned the extent to which reductionism and determinism are actual properties of genetic knowledge, let alone pervasive forces of social control. A consistent objection to this thesis is the hyperbole of its theoretical claims. Concerns about the very nature of socio-technical change have engendered two

complementary responses: some re-articulate the transformational agenda of the 'new genetics' through a more nuanced view of power, while others pursue an empirical agenda of carefully exposing the contingency of geneticization. An important theme that runs through these debates is the varieties of constructionism that seek to analyse biomedical change in terms of its processes and consequences.

This paper aims to reconstruct the geneticization thesis by tracing it back to early political critiques of medicine. Both medicalization and geneticization belong to a family of radical political thought which seeks to liberate the oppressed from biomedical totalities and essences. I will argue that the constructionist style of thinking that underpins these critiques obscures and exaggerates the nature of socio-technical change. In the wake of geneticization, a style of thinking has emerged within the social sciences that embrace the contingency and multidimensionality of biological science. To illustrate this, the paper offers an analytical review of empirical studies that, in various ways, engage with the geneticization thesis. Three domains are explored – disease classification, clinical practice and biosociality – to assess the conceptual utility of geneticization. There are several questions that guide the following inquiry: is geneticization good to think with? Does it accurately describe current developments in biomedicine? And what can we learn from its conceptual history? It is the last of these questions

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with which I begin.

2. The geneticization thesis

The concept of geneticization entered circulation through the work of Lippman, a radical epidemiologist and dedicated activist for women's health. Over the course of three papers (1991, 1992, 1994), she developed a detailed account of geneticization as 'an ongoing process by which differences between individuals are reduced to their DNA codes, with most disorders, behaviours and physiological variations defined, at least in part, as genetic in origin' (1991: 19). The concept encompasses an extraordinary range of processes and effects, a brief summary of which includes: *expansion* of health and illness via genetic technologies; *differentiation* of individuals on the basis of genetic variation; *construction* of biological phenomena through inappropriate labelling of health and disease as 'genetic' rather than social, structural or environmental; *political economy* of disease prediction and prevention; and *socio-cultural* expectations that reinforce the use of genetic technologies, especially in the context of women's reproductive choices.

Lippman's account of human genetics reflects strong political concerns towards science that begin to emerge in the late 1980s. The new alliance between feminism and constructionism challenged modernist narratives of technological progress and scientific objectivism (Harding, 1986; Haraway, 1988). A fertile ground for feminist critique was the objection that science creates 'essences' which effectively naturalize social categories. Geneticization is the extension of feminist arguments about the oppressive use of biology which feeds into a cluster of concerns about:

- *Genetic reductionism* – a scientific methodology that explains biological traits in terms of specific gene functions
- *Genetic determinism* – gene function has powerful causal properties that exclude environmental influences for traits such as disease and behaviour
- *Genetic essentialism* – genes are immutable attributes that impute the identity and function of human life

Many writing about the 'new genetics' have tapped into one or more of these themes. Alpers and Beckwith (1993) express concern that reinstating ideas that traits are 'genetically determined' may justify discrimination and inequality. Nelkin and Lindee (1995: 2) argue that the dominance of modern genetics in popular culture is synonymous with 'genetic essentialism', which 'reduces the self to a molecular entity, equating human beings, in all their social, historical, and moral complexity, with their genes'. Others emphasise that genetic technologies transform human understanding because the gene is a symbol of personhood, identity and social relationships (Hoedemaekers & ten Have, 1998). In this vein, Katz Rothman (1998) writes that genetics is an 'ideology' that explains *everything*: 'Genetics is the single best explanation, the most comprehensive theory since God. Whatever the question is, genetics is the answer' (1998: 13). Van Dijk presents a less unified view of genetics in popular culture. She argues that genetics is a cultural narrative of 'images and imaginations' (1998: 2) that passes through successive stages of historical development.

It is worth noting that these themes are much broader than Lippman's original thesis. This is partly because many of these writers are exploring the public life of genetics as cultural symbols, narratives and prevailing ideas that redefine personhood, identity and sociality. Lippman's account of genetics is a critique of the medical establishment. Indeed, she refers to the 'extensive literature on medicalization' (1991: 27) as a precursor to many of her concerns about prenatal testing. Hedgecoe (1998, 1999) and others (ten Have, 2001; Shostak et al., 2008) have also noted the close

relationship between geneticization and medicalization. It is the conceptual origins of the latter to which I now want to turn.

3. Medicalization

Medicalization shares more than a presumed resemblance to geneticization – the medicalization literature is also an intellectual foundation of sociology's thinking toward biological science. Medicalization has become a staple concept of sociology in adjudicating the relationship between science and society. Most commentators seem to agree that it describes a process of development and change in Western medicine often located within a broader thesis of 'modernization' (Bell and Figert, 2012). The diverse origins of the concept point to an ethos of 'anti-medicine' (Osborne, 1994), a mode of thinking concerned with how medicine developed without regard for the people it serves. The same kind of thinking is preserved in the idea that new genetic technologies are essentially repressive. I want to comment on the political context out of which this style of thinking emerges.

Gerhardt (1989) traces the origins of medicalization to the political turmoil in Europe in the late 1960s, and the perceived failure of Marxism after the 1968 student revolutions. One line of argument emerging in the 1970s focussed on the political economy of health and the growing scepticism towards 'power, profit and politics' of the American healthcare system (Ehrenreich and Ehrenreich, 1970). Another line of argument developed out of the Chicago School broke ranks with Marxism and Parsonian structural functionalism. It understood professional dominance as power to define *deviance*, which formed part of a general cultural pattern of 'blaming the victim' (Ryan, 1971). Freidson (1970) was one of the first to draw on the social construction of professional knowledge. He argued that medicine creates its own privileged universe of knowledge which serves the interests of insiders while objectifying those on whom the knowledge is practiced. Zola (1972, 1975) extended Freidson's ideas in two ways: first, medicine is an 'institution of social control' designed to extend medical jurisdiction, and second, the medicalization of deviance stigmatizes the vulnerable and the powerless.

The idea that medicalization is caused by wider social processes was popularized by Illich's (1976) cultural critique of medicine. What he called the 'medicalization of life' was a full-scale attack on modern society being colonized by three levels of 'iatrogenesis': illness was a by-product of medical treatment at the clinical, social and structural level. A key aspect of Illich's argument is that processes of over-industrialization and bureaucratization of healthcare alienate the person from his or her own body and render them dependent upon medical professionals. However, others claim that these processes are a consequence of political power (Navarro, 1986). Medicalization reproduces a class structure in capitalist society by serving the interests of powerful groups (Waitzkin, 1983) and by creating a system of healthcare around 'commodity fetishism' (Navarro, 1975). In contrast, a social constructionist framework shows that medicalization is a more heterogeneous phenomenon of not only controlling deviance (Conrad, 1975), but allowing various social movements and interest groups to advocate a medical diagnosis for 'new' conditions (Conrad, 1992; Conrad and Schneider, 1980).

Feminist writers have also taken up the medicalization thesis to show how patriarchal institutions use definitions of illness and disease to maintain the inequality of women. They strongly criticize the ways in which women's bodies and experiences have been disproportionately medicalized (Riessman, 1983). Resonating with Lippman's (1991) concerns about geneticization and pregnancy, these studies tend to focus on the explicitly material relations through which pregnancy and child birth are brought under

medical control (Scully and Bart, 1978; Katz Rothman, 1982). The experience of childbirth has become alienating because medical interventions seem to deny women the ability to have healthy babies naturally or they are coerced into accepting obstetric techniques such as epidurals, analgesics, caesareans, inductions, etc.

Michel Foucault has been influential in drawing attention to aspects of medical perception, surveillance and control. His work has been used to emphasise the diverse social and political conditions that governed the formation of medical discourse (Foucault, 1975, 1977). Critics of both medicine and genetics have tended to use Foucault selectively to support a thesis of medical domination, often linking the 'clinical gaze' with a notion of the 'docile body' of the patient (e.g. Armstrong, 1984; Lippman, 1992). Medical knowledge is depicted as part of an expanding 'normalizing gaze' of surveillance that subjects individuals to increasing differentiation and conformity. However, this reading of medical power-as-domination is at odds with Foucault's repeated emphasis on the productive, distributed and relational nature of power (Foucault, 1984). In his later work, Foucault (1997) developed an account of power as immanent in political and ethical practices of freedom. Others have taken up this 'ethico-political' dimension of power to analyse the reshaping of citizenship and subjectivity in contemporary biomedicine (Rose, 2007b).

The medicalization thesis offers an interesting case study of contrasting perspectives of power and control. Marxist, constructionist and Foucauldian perspectives tend to overplay the passivity and dependency of the patient, casting the lay person in the role of 'victim' rather than beneficiary of the medical encounter. Various claims about the 'medicalization of life', 'victim blaming' and the 'reification' of categories overstate the hold that medicine has over contemporary experience. Bury argues that these abstract properties of medical power 'perpetuate an argument without the possibility of refutation' (1986: 158–159). The exaggeration of medical imperialism partly relates to sociology's 'self-serving' ideology of radical scepticism (Strong, 1979), but more importantly it relates to a particular view of power as unilateral, pervasive and repressive.

To summarise, medicalization is not a single 'thesis' but a loose amalgam of arguments and perspectives which find their origin in a kind of anti-medicine thinking. Not all proponents subscribe to this anti-medicine view; some withhold a normative agenda and restrict their analyses to describing processes of medical control, while others seek to critique these processes by highlighting the negative consequences of professional dominance. I propose that there are three key features of this style of thinking.

- *Medicine is a totality*: The origins of this thinking are rooted in organismic and mechanistic metaphors of the relations between parts and wholes. It implies that medical power is an internally generated phenomenon. The increasing jurisdiction of medical imperialism 'grows' or 'evolves' through *relations of interiority* and *linear causality*: non-medical categories become medical categories, deviant behaviours are assigned medical meanings, patients are observed and objectified.
- *Medicine is an essence*: Medical knowledge is often thought to contain an underlying essence of a *medical model* in an epistemological sense or a *control function* in a political sense. Essences overlap with totalities because they provide a blueprint of the whole. They deny that medicine is a multiplicity of relations oriented to different aspects of medical practice, e.g. surgery, paediatrics, podiatry, oncology, epidemiology, general practice, etc.
- *Anti-medicine is emancipatory*: Anti-medicine sometimes contains a nostalgia for medicine that used be more caring and individualizing, more social and ecological. This sentimentalism for the past is historically connected to a utopian view of liberty

where the balance of power and freedom is locked in a zero-sum game. The political goal of anti-medicine is to liberate the human body from medical authority.

In this section, I have argued that anti-medicine is an ethos informed by a variety of theoretical frameworks and traditions. Certainly, early critiques of medicine were more totalizing in their conception of medical power, whereas more recent versions emphasise the multidimensionality of contemporary biomedicine (Clarke et al., 2003; Rose, 2007b). Whether or not these changes reflect social epochs of 'modernity' or 'postmodernity' (Bell and Figert, 2012) is less interesting than asking whether our present conceptualizations are fit for purpose.

4. Reassessing geneticization

Geneticization shares many conceptual characteristics with medicalization. For instance, there is a similar tendency to refer to genetics as a unified totality: a 'cultural icon' (Nelkin and Lindee, 1995), a 'dominant discourse' (Lippman, 1991) and a process of 'genetic colonization' (Lippman, 1992). It implies that genetic knowledge contains an underlying essence of reductionism that restricts conceptions of health and illness. Its emancipatory agenda implies that essentialism is repressive, either excluding marginal social groups or isolating individuals in their own pathology. Furthermore, the moral consequences of genetic explanations intensify individual responsibility and subtly coerce individuals to privately manage their risk.

Debates about geneticization have examined whether its theoretical links with medicalization undermine its conceptual utility. The issue is whether geneticization is too polemic and politically loaded to serve as a useful framework for empirical research (Hedgecoe, 1998). Those who support the concept have argued that it should be understood as a wider cultural activity of discussing 'meanings of genetics' (Van Dijck, 1998: 29). Like the concept of medicalization, it is a 'heuristic tool' for directing and focussing moral debate (ten Have, 2001). However, others claim that geneticization is more a rhetorical device for opposing 'crude reductionism' (Kerr, 2004) and disputing the jurisdiction of genetics over areas of health and illness (Weiner and Martin, 2008).

There is validity in the claim that geneticization mobilizes a particularly rigid view of genetic reductionism. Overemphasising the explanatory power of genes maintains a continuous relationship between past eugenic abuses and present dangers. For instance, Nelkin and Lindee (1995: 203) argue that 'fantasies of biological management encoded in genetic essentialism acquire a sinister cast because they can so readily be made to come true through new biomedical technologies at the infertility clinic or the doctor's office'. Lippman believes that genetic prediction and prevention will promote 'an old-fashioned, conservative and potentially coercive model of medicine' (1992: 1473). These accounts are rhetorically compelling because they overstate the continuity between past and present. They also cast new genetic technologies in the role of amplifying reductionism and determinism.

There is not one kind of reductionism in biological medicine. Reductionism is also a methodological paradigm that seeks to explain biological systems in terms of their component parts. The Human Genome project was genetic reductionism *par excellence*, though its brute force approach to mapping the sequence of the human genome did not result in more determinism. In fact, the relatively modest discovery of 20,000 genes signalled the end of genetic determinism (Fox Keller, 2000) and confirmed that a genome is not a parts list for human physiology. Reductionist techniques have transformed our understanding of genes from being discrete units of heredity with stable effects to fragmentary

units that interact with other genes and environmental factors in complex ways (Freese and Shostak, 2009). The complexity of the genome is a stunning reminder that reductionism and determinism occupy flexible boundaries alongside processes of emergence and indeterminism.

Arguably, geneticization contains an ambiguous thesis about the 'social construction' of reality. Hacking (1999) argues that social constructionist arguments are difficult to pin down because the object being constructed may refer to several different entities (e.g. persons, categories, technologies) while the 'social' aspect of construction may involve interaction between different kinds of entities. The obscurity of the geneticization concept seems to relate to it being a kind of 'complex' in which processes and effects are fused together. Lippman concedes that 'most neologisms confuse rather than clarify' (1991: 19), but insists that geneticization provides a new vocabulary to interpret human genetics. Supporters have identified this multi-levelled reference as a useful resource for public discussion (ten Have, 2001), while others find that it lacks grounding in empirical reality (Hedgecoe, 1998).

Hacking (1999: 49) argues that we need to adopt a more literal sense of construction in terms of 'building or assembling from parts' to give a clearer account of the complex relationship between processes and products. Some have adopted the concept of 'assemblages' (Deleuze and Guattari, 1987) to stress the combinations of spaces, persons and techniques in which contemporary biomedicine is said to be organized (Clarke et al., 2003). Various entities such as genes, persons, technologies, organizations, networks, etc., are capable of acting as components within new assemblages at different levels of scale (Latour, 2005). While the concept has been used in the social science of medicine to characterize the multidimensionality of contemporary medicine, it is usually mentioned only in passing.

Drawing on different elements of Deleuze's work, DeLanda (2006) offers a theory of assemblages that presents an alternative version of construction. He sees the problem of social constructionism as being overly reliant on explaining the relationship between categories and their referents in terms of 'meaning'. While linguistic meaning may well be a component of construction, assemblage theory is concerned with how categories themselves are assembled through heterogeneous parts within a larger matrix of institutions and practices. For DeLanda (2006: 44), the object of analysis is not the 'linguisticity of experience' in a phenomenological sense, but processes of assembly in a 'real' historical sense. Thus medical or genetic explanations create socially embedded dynamics between categories and kinds of individuals. Assemblage theory is a method of 'ontological clarification' rather than a substitute for empirical social science research. By refusing to think in totalities and essences, it offers a theoretical framework for understanding how networks of people, genes and technologies are assembled in novel ways.

The remainder of the paper will explore three areas of the empirical literature on geneticization: disease classification, clinical practice and biosociality. The following review is not an exhaustive list but a selection of empirical and historical work in which authors are explicitly reflecting on the geneticization concept. The task is to read this body of work in terms of 'assembly' to reach some kind of ontological clarity about the usefulness of geneticization.

5. Disease classification

Geneticization presents a distinctly linguistic account of how disease categories are constructed through 'stories' about genetic testing and screening. Lippman's thesis is not as radical as to deny 'a biological reality to disease'; her point is that the distribution of health and disease is the product of 'social and cultural

assumptions' as well as 'vested interests and ideologies' (1991: 17). In this sense, geneticization is a 'dominant discourse' capable of 'conditioning how we view, name and propose to manage a whole host of disorders and disabilities' (1991: 18). Given the extraordinary range of the thesis, it is not surprising that Lippman views her own perspective as 'going beyond' earlier sociological versions of disease construction. It is worth briefly considering the difference between these versions of construction.

Lippman (1991) cites Yoxen's discussion on the construction of genetic disease as the basis for broadening her own claims about the power of genetic explanations. Yoxen also argues that medical and scientific knowledge of diseases is 'socially determined' and yet 'grounded in a material reality' (1982: 144), but his historical account of clinical genetics reveals an uneven distribution of genetic explanations owing to the 'structural constraints of the modern healthcare system' (1982: 148). Genetic knowledge plays a modest role in constructing disease due to continuing professional negotiation over the conceptual relevance of genetics to medicine. The impact of genetic categories are constrained by the interplay of economic and professional interests, the changing composition of medical specialization and the relegation of genetic expertise to research facilities within hospitals. Yoxen's version of construction is not concerned with the intrinsic power of genetic explanations, but the conditions that allow these claims to be produced in the first place. Rather than a unified whole, genetic knowledge emerges haphazardly from competing specializations within medicine.

Others have adopted a similar style of constructionism to eschew the claim that genetic disease is 'whatever we say it is'. For instance, Hedgecoe (1999) seeks to test the concept of geneticization by exploring a neutral historical context where less revolutionary processes are at work. Genetic aetiology is shown to have variable effects, often allowing non-genetic factors to play a role, to present a more cautious and responsible face of research. Hedgecoe (2001) calls this the narrative of 'enlightened geneticization' where scientists construct schizophrenia as a genetic disease while at the same time tolerating phenotypic heterogeneity and multifactorial causation. In a similar vein, Kerr (2000) explores the construction of cystic fibrosis and male infertility as an opportunity to contextualize genetic reductionism. Reductionism is a highly flexible and dynamic process that reflects the instability of genes, symptoms and test results. Like Hedgecoe, Kerr identifies a similar strategy of acknowledging ambiguity and complexity of genetic disease. Rather than a source of difficulty, uncertainty is fundamental to constructing a clinical continuum between cystic fibrosis and male infertility.

The geneticization of disease classifications systems seems to involve more than basic science colonizing the clinical domain. Classification systems are negotiated compromises that have to satisfy the practical requirements of different user communities (Bowker and Star, 1999). Diagnostic classifications must have therapeutic utility for clinicians and patients. The geneticization of diabetes is an example of such a compromise where genetic explanations took over 20 years to dominate the nomenclature due to disagreement among clinicians (Hedgecoe, 2002). Even conditions that were thought to be relatively simple to 'geneticize' have yielded tensions between clinicians and researchers over classification. The geneticization of cystic fibrosis has led to classificatory expansion but it has also produced 'a degree of nosological uncertainty' (Hedgecoe, 2003: 63). While it may be true that some conditions, like coronary heart disease (CHD), have become fully geneticized, genetic explanations form part of a wider archipelago of different and competing assemblies of CHD (Hall, 2005; Weiner and Martin, 2008).

These and other conditions should serve as a warning that geneticization is not a unifying framework that stratifies disease

along genetic lines, nor does it always introduce clarity and continuity into medical classification. For geneticization to work, we would expect a relatively smooth classificatory expansion via linguistic processes – what DeLanda (2006) calls the myth of ‘taxonomic essentialism’. Assemblage theory offers a better explanation for this unevenness by defining the properties of an assemblage in terms of *relations of exteriority*: the identity of an assemblage (whether it being genetic research groups and their human subjects or clinicians and their patients) is always the product of an open-ended process; this process is always *precarious* since other processes can destabilize it; and a process is never a system of pure logic but involves *causal interventions in reality* which may produce nonlinear (variable, unexpected) effects. Thus, the factors that mitigate geneticization arise from the contingent nature of heterogeneous relations between assemblages at different levels of scale.

6. Clinical practice

Geneticization raises the justifiable concern that clinical application of genetic technologies actually ‘constructs’ needs and obligations – simply offering prenatal testing and screening to at risk women implies an obligation to accept the offer (Lippman, 1991). In this sense, pregnant women are more genetically ‘made up’ than men who have become ‘moral pioneers’ of new genetic technologies (Rapp, 1998). Rapp (1998) cautions that reproductive technologies are unevenly distributed, with many working class women (especially from ethnic-racial minorities) refusing to be tested. Dilemmas of the moral pioneer are played out on ‘an uneven and shifting terrain’ stratified in terms of class, ethnicity and gender (1998: 68). Nevertheless, some express concern that women at risk of breast/ovarian cancer are obliged to adopt ‘iatrogenic’ practices of risk management, which impose a burden of ‘genetic responsibility’ on women’s identity (Hallowell, 1999).

The relationship between genetics and responsibility has featured strongly among empirical and theoretical accounts of clinical genetics. Rather than dissolving the relations of the person, genetic categories appear to *reterritorialize* (Deleuze and Guattari, 1987) the familial assemblage by extending boundaries and obligations. For instance, Armstrong et al. (1998: 1658) have shown the ways in which the genetic consultation does not isolate and marginalise but entangle individuals in ‘a web of genetic connectedness’. Geneticization is a process of ‘revealing’ a genetic identity in which responsibility is dissipated in a newly assembled network of biological relations. Novas and Rose (2000) also disagree that geneticization will result in treating the individual as an isolate. They argue that ‘the geneticization of identity has to be located in a more complex field of identity practices’ (2000: 491). In treating identities as multiplicities, there is no good reason for why the ascription of a ‘genetic’ identity should dissolve these or other identities.

Ethnographies of the genetics clinic have shown that geneticization oversubscribes the agency of practitioners. Paternalism may have once been the dominant style of eugenic counselling but it no longer defines the genetics clinic today. The clinical consultation is itself a kind of ephemeral assemblage in which the client emerges as an active and ‘pragmatic subject’ (DeLanda, 2006: 49). For instance, predictive genetic testing for breast cancer has become a ‘clinical encounter’ in which the complex investment and actions of patients and their families are salient features of how genetic risk is framed (Gibbon, 2002). The consultation is a dynamic space of ‘intense bi-directional affective entanglements’ (Rose, 2001: 10) where counsellors employ a variety of techniques for rendering client’s actions, thoughts and feelings into a language that is amenable to professional judgement. While counsellors may

indeed control the format of communication, client autonomy emerges from the clinical assemblage as subjects capable of assimilating diagnostic uncertainty (Timmermans and Buchbinder, 2010) and ambivalent risk information (Arribas-Ayllon and Sarangi, 2014).

Even the construction of a genetic diagnosis does not involve the straightforward application of new technologies. Genetic technologies may confer nonlinear effects which need to be aligned with the existing stability of clinical assemblages. Clinical work reflects a merging of old and new styles of professional reasoning. Shaw et al. (2003: 5) show that clinical decision-making is not supplanted by new molecular technologies, but adjudicated through existing ‘hierarchies and traditions of clinical practice’. Genetic tests may extend the diagnostic repertoire of clinical decision-making, but the value of testing is negotiated in relation to ‘traditional diagnostic techniques of history, observation and examination, investigation and diagnosis’ (2003: 16). For dominant conditions characterized by variable expressivity, molecular testing is not even prioritized as a diagnostic tool since other models of clinical management and psychosocial support are seen to be more aligned with patient experiences (Cox and Starzomski, 2004). Even when used, genetic tests are not definitive instruments for ascribing a disease category. In fact, genetic testing can complicate a diagnosis by asserting a ‘genetic logic’ (Miller et al., 2005) that may disregard the presence or absence of clinical symptoms, or produce unintended consequences that require ongoing ‘bridging work’ on the part of professionals (Timmermans and Buchbinder, 2012). In other words, the preference for stability in the clinical assemblage is defined by whether causal interventions in reality (the implementation of a genetic test) can be productively aligned with professional expertise, patient experience, clinical symptoms and disease categories.

Even now, where new conditions are constituted as non-linear assemblages, it makes little sense to say that the clinic has become a space of reductionism. New biomedical entities are emerging where disease processes are being characterized by genomic complexity and phenotypic diversity. Clinical practices of description and interpretation are oriented to treating mutations as component parts entering into relations of exteriority with other component parts via epigenesis, epistasis, polygenicity, etc. Attempts to stabilize these entities ‘produce temporary agreements on the clinical meaning, relevance and robustness of mutations with regard to possible interventions that must be considered reasonable and acceptable’ (Rabeharisoa and Bourret, 2009: 709). Objectivity in the clinic engenders multiple activities that construct provisional markers and ‘proxies’ of imperfectly known pathological entities, in which case it is difficult to see how the clinic of genomic mutations is essentializing.

7. Biosociality

If the social ontology of genetics emerges from relations of exteriority then the same principle applies to processes beyond the clinical assemblage. When Donna Haraway announced the ‘death of the clinic’ she reasoned that ‘our dominations don’t work by medicalization and normalization any more; they work by networking, communications redesign, stress management’ (1990: 69). Even if her claim about the clinic was overstated, the idea that contemporary biomedicine extends beyond anatomy and depth is well-taken. Practices of calculating risk or revealing mutations also generates new social assemblages that operate beyond the clinic. Rabinow (1996) coined the term ‘biosociality’ to describe the productivity of genetic markers that constitute new categories and groups of people. In part, it describes the ways in which identification of a biomarker combines old and new identity categories in

heterogeneous ways. Indeed, Rabinow's prediction about a biological politics of categories and networks holds more traction than Lippman's concerns about depth and stigma.

The new identities taking shape around genetic knowledge are themselves the product of social assemblages comprising networks of association between new kinds of entities, categories and groups. New forms of patient organization are emerging, some of which take their name from a single genomic variant: 'Such groups will have medical specialists, laboratories, narratives, traditions, and a heavy panoply of pastoral keepers to help them experience, share, intervene, and "understand" their fate' (Rabinow, 1996: 102). In quite the opposite direction of geneticization, many patients will accept or seek to overcome their 'fate' by taking part in advocacy organizations to influence genetic research (Stockdale and Terry, 2002), by forming novel collaborations between professional scientists and patients to co-produce scientific knowledge (Callon and Rabeherisoa, 2003), and by engaging in innovative forms of citizenship to lobby resources for rare genetic diseases (Heath et al., 2004). Genetic research has also intensified a 'political economy of hope' (Novas, 2006) where patients form direct relations with biomedical research to play their part in the production of biological capital (Sunder Rajan 2006). Indeed, the capitalization of health and wellbeing has become a more decisive driver in the search for genetic differences than those based on race and ethnicity (Hacking, 2006; Rabinow and Rose, 2006).

Disease genetics tends to prioritize the classification of risks rather than causes because many common complex conditions elude aetiological explanations. However, there are unusual cases that demonstrate how powerful networks of patients and professionals are assembled around genomic classification. Conditions such as 22q13.3 and 22q11.2 are examples of 'genomic designation' (Navon, 2011) where the certainty of genetic markers gain ascendancy over the clinical uncertainty of phenotypes. Navon argues that genomic designation is a new kind of classification that does not essentialize persons but, to borrow a phrase from Hacking (1995), makes up 'human kinds'. That is to say, where conditions lack clinical coherence, genomic explanations have the power of producing new kinds of people. Even when the science is partial and where conditions are poorly understood, the ability to create identities around genomic mutations is enough to create new communities of shared recognition (Hacking, 2006).

The growth of the Internet is another development that attests to the validity of biosociality. Collective practices of genetic identification have created virtual communities dedicated to rare genetic conditions (Novas and Rose, 2000) and specific genomic mutations (Navon, 2011). In the current market of Direct-To-Consumer Genetic Testing (DTCGT) for common mutations, the twin concerns that commercialization and geneticization will mislead consumers have not come to pass. Instead, we see new forms of participation and 'prosumption' (Toffler, 1980) blurring the boundaries between consumer, producer and expertise (Prainsack, 2014). Though not all people seek gene-based identities or participate in online communities, biosociality seems to offer a better description of the new opportunities for consumers to co-produce genetic knowledge in ways that appear to be changing the relationship between experts and patients. Traditionally, genetics professionals have developed their own ethical codes to mitigate the 'risks of knowing risk'. And yet the rise of 'informational biocitizenship' (Rose and Novas, 2005) may explain how communities are taking responsibility for locating and discussing technical knowledge prior to attending a genetic consultation. Online groups seem to acquire scientific literacy and negotiate expertise in ways that dislodge genetics professionals as gatekeepers of specialized knowledge (Schaffer et al., 2008).

In what seems to be a continuation of biopolitics, genetic

knowledge is to be found among numerous kinds of citizenship projects 'from below' that redistribute the norms of health around an ethic of 'care of the self' (Foucault, 1997). For this reason, biosociality will continue to provide an important framework for thinking about the changing relations between state and community and between experts and lay citizens. Assemblage thinking reveals an affirmative biopolitics that emphasises the productivity of relations between genetic knowledge and subjectivity, though not at the expense of understanding a biopolitics of control (Rose, 2007b).

8. Conclusion

The concept of geneticization is the product of specific political and intellectual debates that have shaped our understanding of genetic knowledge. Perhaps there is value in adopting a kind of 'anthropology of reason' (Rabinow, 1996) to understand the peculiarity of historical events that have shaped this style of thinking in the West. The medicalization critique certainly provided an intellectual platform from which to launch concerns about the repressive effects of human genetics. Like medicalization, geneticization belongs to a style of social scientific thinking concerned with the constitutive power of biomedicine. A distinctly linguistic version of social constructionism exaggerates the essentializing effects of genetic knowledge because it conceives biomedicine as a unified totality of relations; it underestimates the multiplicity and autonomy of individuals, as well as the contingency of genetics and genetic knowledge-production. The issue is whether recent events have rendered this thinking obsolete.

A reconstruction of geneticization serves two purposes. It shows that the style of thinking among social scientists about the consequences of genetic knowledge can be traced back to intellectual concerns about the jurisdiction of biological science. However, by the 1990s, this style of thinking has already run its course – the analysis of biomedicine as a totalizing and essentializing phenomenon is no longer useful or intellectually fashionable. The new style of thinking that begins to appear is one that adopts an increasingly multidimensional perspective to grasp the diffuse and distributed nature of biomedicine and the complex field of identity politics in which these practices occur. Contemporary biopolitics is less concerned with the constitutive power of biological control than exploring the government of freedom through contingency (Dillon, 2007; Rose, 2007b). If genetic risk is a new dimension through which we seek to manage our fateful responsibilities, then it is no longer framed in terms of geneticization. In the era of DNA microarrays, whole genome and exome sequencing, the commercialization and continuous management of *uncertainty* has become a distinct object of contemporary liberal governance.

In this review, I have drawn out elements of the empirical literature on geneticization that reveal the variability and heterogeneity of genetic concepts, practices and technologies. Assemblage thinking is not an explicit property of this literature but indicative of its style of thinking. Rather than an ideology with unlimited explanatory power, genetic categories have a social ontology. They are social entities assembled within networks of competing specializations, arising haphazardly from the interplay of economic and professional constraints. They are not deployed ready-made into this or that domain, but undergo a degree of negotiation and provisional alignment to satisfy the practical requirements of different user communities. The same logic of assembly can be applied to genetic reductionism. As a research strategy, reductionism is not a rigid process of deriving the 'essence' of a genetic condition but of aligning symptoms, mutations and explanations within flexible and dynamic networks of practice. The empirical and transformational agenda of these studies are

complementary in the sense that they expose the variability and contingency of reductionism as contextual rather than ideological processes.

The dynamic character of genetic knowledge is also a feature of the clinical domain. Perhaps one of the major limitations of geneticization is its relatively static portrayal of the clinical consultation. The genetics clinic resembles much less a model of unilinear communication than an 'encounter' between active parties who produce a dense network of action, knowledge and concern. On the one hand, new identities are revealed and assembled within a matrix of biological relatedness, on the other hand it generates affective entanglements of guilt, hope and obligation. The idea that genetic technologies would 'colonize' the diagnostic work of the clinic is also unwarranted. A more likely scenario is a merging of old and new styles of professional reasoning in which the value of testing is negotiated by traditional diagnostic techniques. For many non-Mendelian conditions, attempts to identify mutations are merely provisional markers alongside diverse activities to render conditions clinically meaningful.

The assumption that genetic information generates fatalism or isolation is no longer a focus of recent sociological studies. Emphasis has turned to the productivity of genetic information and the ways in which relational forms of power seek to mutually transform subjectivities to accept uncertainties and to manage risk wisely. Rabinow (1996: 99) predicted a 'new type of autoproduct' in which identification with biomarkers or risk categories would assemble new forms of biosocial community. Actual or virtual groups dedicated to understanding genetic information and new kinds of classificatory regimes are quite literally assemblages of categories, experts and lay citizens who seek to take charge of their fate. Assemblage thinking is useful because it recognises the immanence of power relations, the self-organising processes of networks that form new, often affirmative relations between persons, mutations, categories, explanations, probabilities of risk, etc.

Is geneticization good to think with? The fact that its intellectual, political and scientific foundations have dissolved is good grounds for abandoning this style of thinking. In the tradition of using ugly neologisms to characterize social change then perhaps 'genomification' is a more accurate account of the contingency that geneticization never adequately accounted for. Nevertheless, geneticization continues to wield a rhetorical hold on the social science literature, creating a useful ritual of discussion even when terminologies have outlived their conceptual utility. If there is an 'after' geneticization, as I propose in the title of this paper, I mean this only in the sense that it 'might be the starting point of an analysis, a sign of the need for an analysis, but it should not be the conclusion of an analysis' (Rose, 2007a: 702). A postscript on geneticization is merely to clarify that a new style of thinking has taken shape in the social sciences, one that conceptualizes socio-technical change in terms of its cultural and ontological heterogeneity.

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