

Assets, Commodities and Biosocialities

Multiple Biovalues in Hybrid Biobanking Practices

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Abstract: Biobanks are crucial institutions in the infrastructure of contemporary life sciences. They depend on the participation of donors who give tissues and data. Through their participation, donors can build identities and form biosociality. Biobanks are key sites in the current bioeconomy, that enable the generation of value from those tissues and bioinformation, transformed into assets or commodities. We define biobanks as hybrid zones of heterogeneous practices that blur the boundaries between institutional sectors and ways of producing economic values. On that basis we introduce a novel empirical, realist approach to the analysis of biobanking economies, explaining the different economic and social biovalues that emerge from the practices of valuing and interacting between the researchers, biobank staff and donor participants in specific banking activities. We discuss why STS studies on biobanking should explore the concrete practices through which multiple biovalues as well as biosocialities are produced simultaneously and in configurations of mutual interdependence.

Keywords: biobank; biovalues; bioeconomy; biosociality; participants' identity; practices of valuing.

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I. Introduction

In 2010 Robert Mitchell and Catherine Waldby published an article in which they explored national population-based biobanks as sites of biovalue production. Waldby had previously defined biovalue as the yield of vitality produced by the biotechnical reformulation of living processes (Waldby 2002, 310). In contrast to existing bioethical analyses of biobanks and citizens' participation and issues of informed consent, ownership, or confidentiality, Mitchell and Waldby (2010) emphasized the role of biobanks in the global bioeconomy. They placed the role of participant

involvement as the first ring in a value chain, which transforms donated tissues and the related bioinformation into commodities that generate “surpluses of both profit and health” (Mitchell and Waldby 2010, 333). Participation in biobanking was redefined as a form of clinical labour: i.e. “regularized, embodied work that members of the national population are expected to perform in their role as biobank participants” (Mitchell and Waldby 2010, 334). From this angle, the article discussed the emerging relationships between the biopolitics of donor involvement and the generation of biocapital, asking how “genetic information, biological samples, and patient experience” (Mitchell and Waldby 2010, 333) are mobilized through public sector research institutions, medical charities, small and medium biotech enterprises and big pharmaceutical companies. The focus lay on the resulting relationships of production in this area of the modern bioeconomy. Other perspectives on donor involvement in biobanking enterprises were put to one side, since for Mitchell and Waldby (2010, 336): “characterizing population involvement in biobanks primarily in civil terms makes it difficult to analyze the economic role played by populations”.

The aim of this Special Issue is to re-integrate the analysis of economic biovalue production and reflections on biobanks as sites of identity and sociality production in Science and Technology Studies (STS). The need for this integration arises from the current landscape of biobanks itself and how participants relate to them. Our enquires into the bioeconomy of umbilical cord blood banking (Hauskeller and Beltrame 2016a; 2016b) have shown that multiplex and often hybrid zones of biovalue production emerge from peculiar banking configurations. Such configurations are the outcome of several interlocking elements – they include the biomaterials, technologies, laboratory practices, and regulations involved, but also economic interests, ethical values, as well as participants’ social and personal identities and understandings of community. Participation in biobanking is central to the complex emerging bioeconomies and the related heterogeneous processes of valuation. Ethical, social and identity practices cannot be separated from the processes of economic biovalue creation. They are entangled in and take multifaceted shapes in the diverse banking models and configurations that have been created. Our notion of hybridity is consistent with some novel approaches in valuation studies (Muniesa 2011; Helgesson and Muniesa 2013), where rigid categories of institutional regimes of value production have been substituted by the notion of practices of valuing – i.e. valuing as something people do (Heuts and Mol 2013) – related to multiple systems of worth and moral justification (Boltanski and Thévenot 2006). Hybrid biobanking configurations blur the boundaries between institutional sectors and economic forms of production and circulation. Therefore analytical focus should be on the heterogeneous practices enacted by actors operating in biobanks configurations.

This Special Issue arose from our invitation to STS colleagues to engage in the endeavour to decipher this entanglement of citizens' participation and value creation in different biobank configurations. First in a special track during the 2016 4S/EASST joint conference in Barcelona – “Biobanks: the interdependence between forms of biovalue creation and donor participation” - and in this Special Issue of *Tecnoscienza*. We asked to address the following questions: a) How do different forms of involvements of patients, citizens and other non-expert actors shape biobank configurations? b) How are subjectivities and collective identities shaped by the involvement in biobanking activities? c) How are these varying forms of biosocial participation linked to the production of biovalue, and which kinds of biovalues are generated?

The articles collated engage with these questions by exploring diverse biobanking configurations and situations. They show that individuals' decisions to participate and how are influenced by, and in turn affect, the ways in which different kinds of biobanks are set up and function. Banking arrangements and forms of participation are mutually constitutive, and they have to be studied as generative of the condition of possibility and development for the constitution of identities and biosociality and for the production of economic biovalue.

The concept we propose here expands the pioneering work of Mitchell and Waldby on the political economy of biobanks and the related notions of biovalue and clinical labour as well as on the sociological and STS works on biosociality and citizenship. The aim is to apply these concepts to reflect the contemporary variety of biobanking practices and enlarge the conceptual scope through the problematization of biovalue generation. We do so along three interconnected lines of argument outlined below and supported empirically and from diverse angles in the individual articles. In section two of this introduction we clarify first the importance of the distinctions between tissues biobanks and bioinformation biobanks and between clinical and research biobanks. While these distinctions are often used for analytic reasons, the concrete forms they take in practice have important consequences for the dynamics investigated in the articles in the Special Issue. In section three we discuss how the several configurations and organizational arrangements of biobanks raise questions of ethical and regulatory governance. In doing so they become socially relevant, affecting practices of subjectivity and identity formation and, consequently, the creation of economic and commercial value as well. In section four we examine the formation processes of identities and subjectivities, discussing some operative notions deployed in STS that analytically underpin the analysis of these processes. These concepts and analyses insert the multiplicity of values (ethical, social and identity) involved in participation into the debate on the political economy of biobanking. In section five, we critically discuss the political economy of biovalue production in biobanking, arguing that the focus on actual practices of valuing in hybrid economic spaces shows that the diverse forms of generating

economic value confound the rigid oppositions often used in the STS literature. The oppositions between commodification versus assetization as well as between exploitation of clinical labour versus accumulation by dispossession don't hold in view of contemporary practices of biobanking. Finally, in section six, we articulate a theory of the interdependence and co-constitution of diverse *biovalues* that can inform STS study designs to investigate practices and institutions in the contemporary bioeconomy.

The analytical framework we have developed and the relevance of which is supported by the articles below, does not avoid the theories in political economy or sociology of identity, but begins with open concepts of biovalue(s), biosociality and bioeconomy. This provides scope for an empirical realist approach to adjust what these notions refer to and their conceptual role in the study of local biobanking practices.

2. Tissues and Bioinformation in Clinical and Research Biobanking

Biobanks are crucial infrastructures in contemporary biomedicine. They are collections of biological materials combined with information (personal medical, genealogical, environmental etc.) attached to the samples (Gottweis and Petersen 2008, 5). However, they are not as unified a kind of infrastructure as this definition might suggest. They vary in size, purpose, methodology and institutional arrangements. Biobanks are heterogeneous objects (Corrigan and Tutton 2009, 303). One way to bring some order to this heterogeneity is by distinguishing between *tissues biobanks* and *bioinformation biobanks* and then further differentiate these groups into *clinical* and *research* biobanks. We use these analytic clusters to provide a brief overview on types of biobanking, they do not represent a register into which the multiple kinds of existing biobanks fit neatly and without overlap.

Tissue biobanks are fundamentally repositories of biological materials that are designed to enable their usability for clinical or for research purposes. But many banks operate in both domains: some umbilical cord blood banks, for example, provide samples for both transplantation or stem cell research (Hauskeller and Beltrame 2016a). There is also a class of tissues biobanks that offer a service of personal banking: that is tissues storage for future self- or family use, as do private cord blood banks (Waldby 2006; Santoro 2011) or banks that offer the conservation of endometrial stem cells found in menstrual blood (Fannin 2013). Finally, the tissues stored can be sold for commercial purposes and for profit (Almeling 2017; Waldby 2015), or can be release for clinical needs following a logic of public redistribution. Between those types of use several intersection zones have emerged, which we call hybrid bioeconomies (Hauskeller

and Beltrame 2016a). Compared to bioinformation biobanks, these different banking models are characterized by material interests in the tissue as such, be they clinical, scientific, and/or commercial interests. Medical information about donors and other bioinformation (e.g. medical history) are collected to determine the properties of the tissue to realize its future use-value.

In bioinformation biobanks the focus lies on the information provided. Tissues are collected to extract bioinformation that is then correlated with other information; value (again: scientific, clinical and/or commercial) is generated from the size, the richness and the usability of that information. Scholars often call these biobanks genetic (or genomic or DNA) databases, databanks or biolibraries (Hoeyer 2008, 429; Corrigan and Tutton 2009, 303).

Gottweis and Petersen (2008, 6) called such banks “population-based research biobanks”, highlighting that samples and data are taken from “(parts of) the general population with or without disease”. This denominator stresses other characteristics of these enterprises: a) they are mainly oriented toward research; b) they work on populations and, more importantly, c) populations can mean either or both, the general population and a specific population that carries a specific trait or condition. The explanatory power of these initiatives is taken to rest in combining genomic data (extracted from the blood samples collected from a population, for instance) with the medical records, genealogical, environmental and lifestyle information. Also, the research-oriented focus does not exclude future concrete and commercial applications of the findings. The data are analyzed both for a better scientific understanding of the etiology of diseases and conditions, and to develop new diagnostic tools (e.g. genetic tests), therapeutics and pharmaceutical products (Tutton 2004; Lewis 2004; Corrigan and William-Jones 2006).

The size of dataset collected is often less important than the detail and quality. Valuable are, depending on the research questions, the genetic homogeneity of a unique population (the Icelandic case, see e.g. Rose 2001; Pálsson and Rabinow 1999); or a relatively large population about which exhaustive medical records can be accessed (the Swedish LifeGene initiative, see Cool 2016); or, finally, a large sample of a multi-ethnic population (as in UK Biobank, see Tutton 2008). The aim of the research affects how homogeneity versus variability can be valued (Tupasela 2016). Respectively, the notion of “population” varies including so-called genetic isolates or people affected by a specific health condition – in disease-specific biobanks (see the case Singh presents in this Special Issue).

In bioinformation biobanks any distinctions between commercially-oriented activities and research initiatives are even more difficult to draw out than in tissue biobanks. While the for-profit aim is the reason for the existence of “direct to consumer genetic testing” companies (Tutton and Prainsack 2011; Harris et al. 2013), STS scholars have also discussed the potential commercial implications of population-based biobanking pro-

jects (Mitchell and Waldby 2010; Tupasela 2016). Recently, population-based biobanks have been investigated also as sites for the construction of collective identities intertwined with the generation of both scientific and economic value (Tupasela and Snell 2012; Tupasela and Tamminen 2015; Tupasela et al. 2015; Cañada et al. 2015).

The scope of biobanking initiatives, the target of their collection strategies, their research or clinical aims shape the processes of identity construction and value generation. The contributions to this special issue discuss different kinds of biobanking activity. Romero-Bachiller and Santoro explore different banking practices around a human fluid, human breast milk, and show how it is differently bio-objectified in different banking configurations engendering kin-like relations and identities built on narratives of donation, altruism and gift-giving. Singh discusses a disease-specific genomic database in which tissues are also used to derive immortalized cell lines and induced Pluripotent Stem Cells (iPSCs) that can be exchanged and used as disease models for research. Wyatt, Cook and McKevitt analyze a biobanking activity which depends on continuous long-term engagement of volunteer participants. Bühler, Barazzetti and Kaufmann explore two different bioinformation biobanks a city-cohort study oriented toward specific diseases and a general biobank aimed at the development of personalized medicine. Whereas French, Miller and Axler discuss the engagement hospitals have in different kinds of biobanking activity.

The range of different configurations and orientations to tissues and/or bioinformation addressed highlights the diversity of processes of biovalue production on the ground. In order to better understand these processes, the tissue/bioinformation distinction is insufficient. We also need an explanatory articulation of the contemporary institutional configurations in biobanking.

3. Institutional Configurations

Gottweis (2008, 24) concluded that biobanks are technologies of governing life through “collecting, storing, interpreting, and assembling life in the form of human materials, such as tissue or DNA”. As such, they involve a continuous re-definition of the boundaries between “the scientific/technological, the social, the cultural, and the political” as well as the “relationships between patients and doctors, between genes and diseases, scientists and the public, the pharmaceutical industry and medical sciences” (Gottweis 2008, 22). Biobanks are also key sites in the current bioeconomy. They enable the transformation of tissues and bioinformation into exchangeable commodities, or assets producing rents through patenting or other financial strategies. We argue that the examination of biobanking should be wider than focusing primarily in a logic of “corpo-

ratization and commodification of healthcare and medicine” that results from the active intervention of private companies in the field of contemporary biomedicine (Gottweis 2008, 28).

One key element of the analytical framework we propose is the hybrid nature of biobanking economies. Hybrid bioeconomies criss-cross and overstep distinctions drawn between public and private institutions, redistribution and market economy, or commodification and assetization (Hauskeller and Beltrame 2016a). Hybridity means firstly that organizational configurations and institutional arrangements cannot be used as fixed explanatory categories for economic value production. The analytical focus should be put on the practices of valuation enacted by the involved actors within the peculiar configurations in which they operate. Secondly, hybridity implies that these practices encompass a complex of different non-economic values (e.g. scientific reputation, international collaborations, healthcare benefits, individual and collective identities). Therefore, the exploration of different organizational and institutional configurations of biobanking enterprises is not merely a classifying task, it is a step toward the explanation of the production of multiple biovalues by enacted valuing practices within these configurations.

Our perspective contrasts with the three ideal types of institutional models proposed by Gottweis and Lauss (2011) to capture the range of bioeconomic configurations:

- 1) The *entrepreneurial biobank*, founded by a commercial company often in partnership with state institutions;
- 2) the *biosocial* biobank, an enterprise promoted, funded and sometimes managed by patient activists' groups;
- 3) the *public biobank*, established, funded and ruled by state authorities or by charities and the not-for-profit sector.

These ideal types of banking arrangement overlook cases of public-private partnership in biobanking and public biobanking enterprises established through licensing agreements with a commercial pharmaceutical or biomedical company (see Pålsson 2008; Lewis 2004 for a typology of forms of pharmaceutical companies' engagement in biobanking activities). Similarly, the biosocial model forms a hybrid through partnership with commercial companies. The well-researched cases of PXE International (Novas 2006) or the Association Française contre les Myopathies (AFM) (Callon and Rabeharisoa 2008; Mayrhofer 2008; 2015) exemplify biobanking activities that have been initiated, funded and managed by patient organizations yet have licensing agreements with commercial biotech companies.

Corrigan and Tutton (2009) offer a more exhaustive list of possible configurations, organized according to the sources of the biomaterial and information, the research foci, the actors initiating biobanking activities and the expectations of these endeavours (see Table 1). However, this classification excludes both most of the existing tissue biobanks (that provide or sell tissues for research or clinical treatments) as well as those

commercial enterprises that sell genetic tests directly to the consumer. Moreover, Corrigan and Tutton (2009, 304) add that:

many biobanks have been initiated, funded or undertaken by alliances of actors, ranging from collaborations between (1) publicly funded universities and hospitals; (2) public-private partnerships comprising commercial companies; (3) the academic sector and/or medical charities in cooperation with national and regional governments; (4) pharmaceutical, biotechnology and genomic companies in collaboration with clinical research organizations; and (5) disease advocacy organizations in collaboration with universities or even pharmaceutical companies.

It has been observed in recent years that many of these alliances were not established at the beginning of a biobanking initiative. Collaborations as well as commercial agreements and deals can be stipulated during the course of the collection and storage activity. This suggests that the types proposed by Gottweis and Lauss (2011) do not exist in a pure form, instead complex configurations have been emerging. Mayrhofer and Prainsack (2009) have argued that the network structure of collaborating biobanks is increasingly diffuse, and involves more and more partnerships across the public and private sectors, the domestic and international dimension, and the healthcare, research and commercial clusters (see also Tupasela and Snell 2012).

<i>Sources</i>	<i>Research Foci</i>	<i>Actors</i>	<i>Expectations</i>
Population-based prospective (volunteers from the general population)	Common, complex diseases	National or regional governments	Prevention and treatment of disease
Hospital patients	Personalized medicine	Medical charities	Reduction of health-care costs
Patients or other volunteers participating in clinical trials	Cancer research	Pharmaceutical sector	Speed up drug development and approval
	Orphan and rare diseases	Teaching hospitals	Generate new income stream for pharmaceutical sector
		Diseases advocacy groups	Produce 'personalized' drugs for sub-groups or individuals
		Biospecimen industry sector	

Table 1 – Varieties of biobanks and their scientific and institutional settings (Corrigan and Tutton 2009, 304).

Studying banking configuration is more than an exercise in arranging elements according to characteristics for the sake of it and, like all classification exercises, neither objective nor exhaustive. Yet, given that policies and ethical discourses on biobanking have mobilized and often rest their rules and judgments on such classifications, it is necessary to discuss them and contrast them with developments in the field. Only then can one observe and analyze the increasing *hybridity* of biobanking practices and its implications for the production and social appreciation of the implicit and manifest *biovalues*.

Firstly, configurations affect biobanking governance. According to Gottweis and Petersen (2008, 8), we witness “multi-directional forms of governance”, where the traditional top-down approach coexists and intersects with bottom-up patterns (biosocial banking model) and with “horizontal exchanges” between market actors. Mayrhofer and Prainsack (2009, 75) argue that network configurations involve a form of “governance emerging out of the field itself”: effective collaboration requires reliable standards of data collection and management as well as harmonization practices and ethical conduct. These elements produce materially binding (even if formally non-legal) protocols and guidelines of practice. Mayrhofer and Prainsack (2009, 70) also note that governmental regulation is not as fast as the progress of scientific activity, instead it is the research activity itself that generates forms of governance, enforcing also ethical conduct in procuring, processing and using samples and information. This implies a shift in the focus from formal institutional arrangements to the concrete social practices and interactions that make biobanking configurations work. Cooperation and the sharing of tissues and bioinformation require work to embed the activity in the social context (Hoeyer et al. 2017; see also Tupasela and Snell 2012).

Secondly, institutional configurations have implications for processes of commercialization and economic value production. Commercialization is a thorny issue in the debate about ownership of the donated tissues and bioinformation given to biobanks. The question is how altruistic gift-giving of participants is transformed into or becomes part of a proprietary asset and/or commodity (see Hayden 2007). The private sector is interested in accessing the tissue and bioinformation collections stored in hospitals and public biobanking initiatives for profit-making reasons (Lewis 2004). STS scholars have investigated the reactions of donors to the transformation of their “gift” into a commodity, showing that healthy volunteers are more critical than patients and ill people, who instead tend to accept commercial agreements as a “necessary evil” in the development of treatments (Haddow et al. 2007; Tupasela and Snell 2012; Hoeyer 2013). Participants justify their willingness to donate with their trust in medical institutions such as hospitals, and this trust arises from the perception that they are oriented toward healthcare (Tutton 2004; Busby 2004; Busby and Martin 2006; Hoeyer 2008). For that reason, a commercial orientation added to such public banking enterprises can challenge their legit-

imacy and give rise to what Pálsson (2008, 47) has called the “bio-politics of the dispossessed”, the strong opposition of actors who felt deprived of the control and security they had enjoyed over samples and bioinformation and the relation of trust that grounded their participation.

STS scholars, often in dialogue with bioethics, have explored the available legal and regulatory mechanism for solving such quandaries through exploring forms of consent and public oversight (see Corrigan and Tutton 2009; Hoeyer 2008). This Special Issue concentrates on the practical accomplishment of addressing potential commercial uses of tissues and bioinformation in the interactions between biobank staff and participants. French, Miller and Axler discusses especially how hospitals configure their biobanking initiatives in order to leverage the commercial potential of their privileged access to samples and health records whilst maintaining the social license that derives from their healthcare orientation. Locating their analysis at the meso-organisational level, they highlight the work that goes into aligning the “entrepreneurialization” of care with the socially legitimate healthcare obligations in biobanking configurations. Wyatt, Cook and McKeivitt analyze in-depth the everyday work of biobank staff, their numerous decisions and negotiations to enlist engaged volunteers to participate in research with potential commercial applications. Romero-Bachiller and Santoro in this issue explore configurations in human milk banking focused on the situated practices of donation and on how the different regimes of bio-objectification and use of this fluid are intertwined with the construction of relationships and identities. In contrast, Singh presents a study on a form of biosocial bank – established and funded by a non-profit foundation – where donated tissues and data are also made available for potential commercial applications.

The articles have in common that the banking activities analyzed happen in what we have called hybrid zones (Hauskeller and Beltrame 2016a). The frequent hybrid organization of contemporary biobanks suggests that STS studies of this field might shift focus from analysing static institutional arrangements and banking models to examining the logics enacted, shaped and hybridized in the everyday work of participants and biobank staff. This Special Issue contributes theoretically and empirically to the study of how the specific institutional *gestalt* of contemporary biobanks is not always as designed at the outset. It is instead shaped by the engaged practices of the diverse actors involved, from which also the production of economic, social and personal *biovalues* results.

4. Participation and the Construction of Identities and Forms of Biosociality

Issues related to participation are often debated in STS literature in a dialogue with bioethics that is sometimes critical, sometimes constructive.

This dialogue has produced some normative pronouncements about the *right and just* way of involving donors and to critical discussions about the practical modalities of such involvement. Our contribution complements this work by looking at participation in biobanking as a site for the construction of identities and forms of biosociality, which we consider important *biovalues* in our analytical framework.

The point of departure of the analytical framework we propose in this introduction and which is supported in the original articles by, is that, as convincingly argued by Tutton and Prainsack (2011, 1082), “discursive and material practices of recruitment and conditions of participation” produce different subjectivities. Scholars have shown how the legal mechanisms of informed consent are also a technique that produces the donor subjects as neoliberal, empowered citizens, autonomous political agents who make choices based on risk-benefit calculations to improve their wellbeing; subjects with the right and the duty to participate (Corrigan 2004; Hoeyer 2004; Tutton 2007). Moving the analytical centre away from the legal mechanisms and formal engagement procedures, we focus on the practical and pragmatic management of participation enacted by involved actors (researchers, biobankers and participants). The aim is to add another dimension to the STS analyses of subjectivities, identities and forms of biosociality, to point out some of the limits of studying mostly formal mechanisms of participation, instead of human interaction and sense-making.

The integrative and complementary perspective we propose draws on Haimés and Whong-Barr’s finding that participation is “a highly varied social process, with multiple meanings”, involving “levels and styles of participation” as well as “variations in the meanings and processes attached to the decision-making” (2004, 57). Participation is considered as “an analytical framework” that enables researchers to explore “the multiple and complex subject-positions that people occupy” in biobanking activities (Tutton 2007, 176). This Special Issue explores the situated, contingent and context-dependent social practices of *making* participation. The specific forms of participation discussed emerge from the interactions between the researchers and biobanks’ operators and the participants. This analytical angle, centered on situated practices in the contributions, allows analyzing the production of *biovalues* in relation to personal as well as collective biosocial identities.

Firstly, we look at the construction of collective identities. Several STS scholars have explored how population identities are co-constructed through processes of characterization involved in biobanking initiatives (Nash 2012; Tupasela et al. 2015; Tupasela and Tamminen 2015; Tupasela 2016). In order to characterize samples and data collected from a population, ideologies and historical narratives about ancestry and ethnicity are mobilized and thus genetic traits are linked to notions of cultural heritage and nationhood. However, it is debatable whether these forms of populations characterization are sufficient in themselves to constitute a

politics of identity and contribute to the building of collective identifications. Prainsack has underlined that, rather than *producing* identities, biobanks may “play an important role in *reinforcing* collective identities” (Prainsack 2007, 97, emphasis added).

Here the creation of identities is studied not as the effect of how participants have been characterized, but as actively produced by participants through their interactions with biobank staff. Bühler, Barazzetti and Kaufmann in this issue discuss the construction of populations in two different biobanking initiatives in Switzerland, a city cohort project and a general bioinformation biobanks oriented toward personalized medicine. Their study shows that the strong engagement in the city cohort is based on a shared identity and sense of belonging not engendered by formal mechanism of participation, nor exclusively by the local setting. It is the outcome of the long-term everyday interactions between biobank staff and participants. The former provide regular medical feedback to the latter, transforming participation in a strong care relationships. In contrast, the general bioinformation biobank, even if it deploys formal mechanisms of participation, is not able to activate similar processes of identification. Bühler, Barazzetti and Kaufmann’s article demonstrates that characterizing populations through the combination of genetic relatedness and a rhetoric of common heritage is not enough to mobilize engaged collective participant identities. These emerge from the resonance between a specific biobank research orientation (the city cohort), the identifiable local setting (the city) and the socially embedded practices of interaction with participants.

The role of situated practices of interaction and participation is also thematic in the articles that draw on the concept of biosociality, a key (social) biovalue constitutive for ethically and socially, and hence scientifically, successful biobanking activities.

Biosociality, and the related notion of biological citizenship (Rose and Novas 2005), is often evoked in STS analyses of biobanking, and sometimes taken for granted. In our analytical framework, however, biosociality is problematized in relation to how it comes about. Biosociality was introduced by Paul Rabinow (1996, 241) to refer to “a truly new type of autoproductio[n]” around biological features that emerge from practices that simultaneously generate knowledge, modify nature and reassemble identities and social formations (see also Gibbon and Novas 2008). Biosociality and the related notion of “biological citizenship” (Rose and Novas 2005) intend to address “modes of subjectification, through which individuals are brought to work on themselves...by means of practices of the self, in the name of their own life or health, that of their family or some other collectivity” (Rabinow and Rose 2006, 198). These notions highlight the active political involvement of individuals resulting in the construction of communities of identities and biosocialities through new ways of “forming novel relations with figures of scientific or medical authority in the process of caring for, and about, health” (Rose and Novas 2005, 446) and

in “an active role in shaping the direction of science” (Rose and Novas 2005, 452).

The articles in this Special Issue, with their focus on biobank participation, show empirically that biosociality and biological citizenship are neither an effect of formal participation mechanisms nor the outcome of participant population characterization. Biosocial banking models as defined by Gottweis and Lauss (2011), namely as sites where biosociality and biological citizenship are produced, do not do so because of peculiar organizational arrangements. Rather, the production of biosociality as well as the “partnership model” in research and decision making (Mayrhofer 2008) are the effect of the active political engagement of patient associations initiating and managing these banks (Novas 2006; Callon and Rabeharisoa 2008; Mayrhofer 2008; 2015). Furthermore, Sunder Rajan (2008) has shown that a shared biological identification is not sufficient to generate forms of biosociality. “Experimental subjects” participating in global clinical trials in developing countries are passively subjected in modalities set by these markets. Biosociality develops only under *structural conditions* that enable participants to contribute and engage as active political subjects (Sunder Rajan 2008, 178-179).

We argue that these structural conditions for the development of biosociality include the practices of participation enacted and the interaction between biobanks staff and participants as a key factor. Jennifer Singh shows how participants in a large autism genetic database create a form of biosociality through participation and the virtual connectivity enabled by the digital network platform developed by the funder. With the donation of blood and information, the participants obtain a standardized and official clinical evaluation. This return, or “diagnostic currency”, is important besides the access to dedicated educational and support services it allows. It is crucial for addressing anxieties, distress and uncertainties concerning the condition of their children. Participation is a way to confirm the medical and social legitimacy of the diagnosis. The search for a genetic cause of autism answers to parents’ uncertainty about the causes and allows them to build narratives of doing something for their families and for the general autistic community that enacts a common biosociality (see also Singh 2015). Biosociality is effected by active participation, in the exchanges and relationships with researchers and with other families on the digital network platform. Finally, Singh’s analysis details how the peculiar configuration of the biobank and the fact that the research includes only one specific patient family configuration channels the production of biosociality through the exclusion of other family structures and biases against ethnic minorities, single parents and other economically disadvantaged groups.

The role of interpersonal interactions in enabling biosociality is also emphasized in the analysis presented by Wyatt, Cook and McKeivitt. They have studied the ongoing, every-day recruitment work of biobank staff whose job it is to sign-up and maintain the long-term engagement of vol-

unteers in biomedical research. Romero-Bachiller and Santoro elucidate how the different practices of human milk donation, sharing and technical manipulation not only enable the circulation of this human fluid and the contained bacteria and microbiota, but engender forms of intercorporeal sharing as a site for the construction of biosocialities through the development of altruistic engagement and reciprocity, imperatives to care, trust and emotional identifications.

The contribution of this Special Issue to the STS debate on biobanking is to establish an analytical framework to decipher the *scale* and *grade* of participation in relation to local biobanking configurations and the work of all participating agents. In this way, we can elucidate the structural conditions for the *differentiated emergence* of biosocialities and other *biovalues* instead of positing them as a fixed feature of biobanking participation and/or institutional configurations.

5. The Production of Economic Biovalue in the Hybrid Bio-economy of Biobanking

A complex debate has unfolded in STS over the political economies and economic theories that are most plausible to explain the phenomena that can be observed empirically. The dispute concerns especially the notions of biovalue and how it is created. The focal points lie either on the contribution of material and information from patients, which has been criticized by some as a form of exploitation of clinical labour. The alternative position emphasizes that it is the labour of professionals that transforms stuff that has been donated into an asset through appropriation and the work involved in making it accessible.

This debate is important for our perspective, and that is why we present it here in some detail, to then argue that these perspectives are not separate or stand in a clear hierarchy of relevance for the creation of *biovalues*. There is more to *biovalues* than material and societal processes of exploitation and assetization. This Special Issue presents new theoretical and empirical work on the creation of *biovalues* in biobanking and widens considerably the meaning of bioeconomy in Mitchell and Waldby's work (2010). Recent empirical findings present a rich hybrid tapestry of biobanking and related bioeconomies. Studying forms of engagement and participation in relation to research and institutional agendas highlights that *biovalues* are not just financial revenues. Multiple kinds of values are involved in biomedical activities and contribute to the societal, scientific and economic performances of biobank projects.

In economic terms, biobanks are conceived as important nodes in what Waldby and Mitchell (2006, 31) have called "tissue economy", that is any "system for maximizing" the productivity of tissues "through strategies of circulation, leverage, diversification, and recuperation". Genomic sequences and digitalized health, genealogical and environmental data are

transformed into commodities that generate biovalue through the linking of “various types of pharmaceutical and diagnostic biocapital” (Mitchell and Waldby 2010, 337). In this way, biobanks are made part of a view of the so called bioeconomy that defines it as the commercial dimension of the life sciences, biomedicine and biotechnologies in a market-economy framework (Birch 2012; Petersen and Krisjansen 2015; Pavone and Goven 2017). Taking this perspective, terms such as *biocapital* and *biocapitalism* (Sunder Rajan 2006; Rose 2007) are often used to identify bio-economic activities and to give a sense of the increasing insertion of “the substances and promises of biological materials... into projects of product-making and profit-seeking” (Helmreich 2008, 464), in modes of value creation that follow the logic of capitalist processes of production and accumulation (Franklin and Lock 2006; Sunder Rajan 2006; Cooper 2008).

As Helmreich notes, this understanding focusses the analysis and reflection on the dynamics of labour and commodification (2008, 464). Commodification is inherent to the same notion of biovalue introduced by Waldby (2002). As “the yield of vitality produced by the biotechnical reformulation of living processes” (ivi 310), capitalization of biovalue occurs through the transformation of biological matter into commodities bought and sold on the market. The category of labour is instead introduced by a reframing of the notion of participation in biomedical activities.

Mitchell and Waldby (2010) indeed conceive participation in biobanking as a form of *clinical labour*: that is, embodied or bodily-embedded work, largely unrecognized, that produces economic value through “subjects giving clinics access to the productivity of their in vivo biology, the biological labor of living tissues” (Waldby and Cooper 2008, 59; see also Cooper and Waldby 2014). Clinical labour encompasses the donation of tissue for medical research as well as to more onerous forms of involvement like participation in clinical trials (Sunder Rajan 2006; Cooper 2008). The provision of oocytes for assisted conception and stem cell research, surrogate pregnancy, and the selling of organs and other bodily tissues as a means of making a living (Waldby 2008; Waldby and Cooper 2008). In the case of bioinformation biobanks, clinical labour refers to the life of the participants (their medical history, their everyday nutrition habits and exposure to environmental factors) that is accessed and valued through data mining techniques (Mitchell and Waldby 2010). Biovalue resides in data obtained, and is realized through their commercialization (as commodities) and the exclusive appropriation of the intellectual property rights on them. Thus clinical labour is associated with the notion of “free labour” introduced by Terranova (2000) to denote how the activities of Internet users constitute an unpaid labour that produces revenue. Participants are at the same time producers and the consumers of the biomedical commodities thus produced (Tutton and Prainsack 2011; Harris et al. 2012).

Recently this concept of the bioeconomy based on commodification and clinical labour has been challenged regarding the meaning of

biovalue (Birch and Tyfield 2013; Birch 2017) and this critique constitutes part of the analytical framework we present here. Our understanding of biovalue and how *biovalues* are produced combines insights from Waldby and Mitchell but unfolds the multiple kinds of *biovalues* that play a role in biobanking and in the related bioeconomies and biosocialities.

Birch and Tyfield (2013) argue that the notion of biovalue is misleading, there is nothing valuable in biomaterials (tissues and/or bioinformation) *per se*, but what is valuable is the health they can provide (2013, 304). This value of health, or vitality, is socially constituted through ethical and political values, it is not an economic value inherent to the biological characteristic of biomaterials (ivi 308). Secondly, if the economic value is realized in the market exchange of products providing health, value is produced by “the knowledge and knowledge labor required to transform ... [biomaterials] into commodities” (ivi 308). Birch and Tyfield insist, however, that value in the bioeconomy is not mainly realized through commodity-based market exchange. The view that the biological as such has no inherent economic value has several interrelated implications.

The first is that value is generated by knowledge labour of researchers and other professionals who transform bioresources into a “commodity of some sort” (ivi 313). This implies that the procurement of biomaterials is a practice located somewhere between an appropriation of resources and the exploitation of (unwaged) “labour”. Both Birch and Tyfield (2013) and Cooper and Waldby (2014) in a subsequent reformulation of the notion of clinical labour have relied on the theories of Italian post-workerist Marxists argue that in the post-Fordist mode of production the emerging biocapitalist process of accumulation is penetrating life itself. Instead of the *subsumption* of productive labour, the new logic of accumulation works through the subsumption of “subjectivity itself, in its experiential, relational, creative dimensions” (Morini and Fumagalli 2010, 240). The collapse of foundational distinctions that characterizes the concept of productive labour— such as that between the time of work and the time of life, production and reproduction and production and consumption – implies that a “theory of life-value” has to replace the classical “theory of labour-value” (ivi 236). Whereas Birch and Tyfield (2013) use these notions to argue for the inconsistency of the category of clinical labour, Cooper and Waldby use it to expand the meaning of the concept of labour:

the life science business model is organized around a classical (Lockean) labor theory of value which identifies the cognitive labor of the scientist as the technical element necessary to the establishment of intellectual property in living matter. (...) In this account, the bodily contribution of tissue providers and human research subjects appears as an already available biological resource, as res nullius, matter in the public domain, even while in practice the mobilization of these providers and subjects represents a growing logistical problem for the life science industries (Cooper and Waldby 2014, 9, original emphasis)

Cooper and Waldby maintain that tissue and bioinformation provision can be defined as a form of labour as it requests the mobilization of providers and it is based on the alienation of biological resources intended as the product of clinical labour. However, defining the bodily contribution as “an already available biological resource” in the public domain, appropriated by intellectual property rights, confounds the insistence on participants’ clinical labour as the crucial factor that creates biovalue. It recognizes the mechanisms of value appropriation and of *accumulation by dispossession*.

This is the second implication of Birch and Tyfield’s criticism (2013). In their view, the subsumption of biological and vital aspects implies that value is generated by subjecting the knowledge necessary to that subsumption to regimes of intellectual property rights. Applying the reflections of David Harvey (2010; 2014) and Christian Zeller (2008) on the process of accumulation by dispossession, Birch and Tyfield argue that value is generated from the extraction of *rents* from appropriated resources through a regime of property and monopoly. Intellectual property rights regimes act as mechanisms of enclosure: they enclose knowledge and natural resources, dispossessing others from the property and enabling the exclusive appropriation and the monopoly over the materials to generate rents (see also Birch 2012; 2017).

Consequently, the third implication is that rent-seeking strategies are not based on the direct exploitation of labour and commodification, when natural resources and knowledge are transformed into assets. An asset is “a tangible or intangible resource that can be used to produce value and, at the same time, has value as property” (Birch and Tyfield 2013, 302), while a commodity is produced for being exchanged as its value is realized only in exchanges. Assets can generate value also through other finance-dominated strategies of accumulation. As explored also in other work by Birch (2012; 2017), patents are the objectification of the intangible value of biological and knowledge property held by a firm. Revenue streams coming from patents are realized “from the trading of shares or investments in the firm (i.e., financial assets) or intellectual property (e.g., knowledge assets) and not from trading a material commodity produced by that firm” (Birch and Tyfield 2013, 311). Financial speculations are thus based on “the more mundane political-economic” promises of the rising value of shares in firms (Birch and Tyfield 2013, 322), what Birch later called a process of capitalization (2017, 466). In other words, in their understanding the bioeconomy is not commodity-based, but is asset-based: it is an economy aimed at asseticizing natural resources and biotechnological knowledge in which value is generated through rent-seeking processes that operate financial strategies of accumulation in asset-based markets.

Our approach does not require taking sides in the debate over commodification versus assetization and clinical labour versus accumulation

by dispossession. We conceive the economy of biobanks as a hybrid bioeconomy, which means that those different processes of biovalue production can occur simultaneously and with varying dominance and overlap. The configurations analyzed in the articles, their different institutional setting with different biomaterials collected and exchanged, demonstrate that concrete biobanking activities cannot be encapsulated once for all into a rigid dichotomy between commodity-based economy and asset-based economy. We do not set a certain regime of valuation as the starting point or core of the analysis. Instead we focus the analytical gaze on the enacted practices in the situated configurations that shape the production of *biovalues* according to processes of commodification or assetization.

Romero-Bachiller and Santoro explore the circulation and different forms of bio-objectification of human breast milk, including a regime of public redistribution to informal sharing economies based on interpersonal gift-giving, but also a commercial factory context in which the donated milk is used to derive potential bio-commodities (patented probiotic products that employ bacterial strains to treat mastitis in lactating women). French, Miller and Axler investigate the establishment of biobanking activities in entrepreneurial hospitals. They show that in the attempt to leverage economic benefit from their unique access to patient tissues and medical information these institutions employ a logic of assetization rather than commodification. Singh unfolds the different uses of the donated materials in the SSC autism genomic database, insofar as alongside the study to find links between copy number variants (CNVs) in the genome and autistic phenotypes, the SSC also sells lymphoblastoid cell lines and iPS cell lines derived from the donated blood samples (i.e. commodification).

Concentrating now on the second common debate among scholars on the labour involved in the bioeconomy, we also see not an either-or situation but a continuum of practice. Not much is gained from a blanket critique of an exploitation of the donor's clinical labour or capital value through accumulation by dispossession of donor's biological resources. Empirically the provision of tissues and bioinformation in any biobank is influenced by the interplay between biobanking configurations and the concrete practices of valuing that are enacted in and around the activity. The provision of biomaterials is shaped in concrete biobanking contexts by a complex of institutional settings, ethical and moral norms enforced by legal mechanisms and enacted by involved actors, as well as by the power relations among them.

Feminist bioethicists have shown that the procurement of oocytes and surrogacy in assisted fertilization are a form of exploitation of clinical labour (e.g. Dickenson 2001; Waldby 2008; Widdows 2009). At the same time, sociologists have characterized the appropriation of supernumerary IVF embryos for stem cell research in developing countries as accumulation by dispossession (Glasner 2005; Gupta 2011). In the most recent study we have been conducting on cord blood biobanking, it is difficult

to identify either forms of exploitation of labour or accumulation by dis-possession: in public banking an otherwise discarded tissue is collected but then redistributed for public medical needs; in the private banking sector this bioresource is valued precisely because it is owned as a private biological asset (Hauskeller and Beltrame 2016b). Commodification takes different and hybrid forms in which the banking service itself is more consistently commodified than is the biomaterial (*ibid.*).

Wyatt, Cook and McKeivitt address specifically the limits of the notion of clinical labour as applied to participating volunteers in the UK BioResource. This institution is not simply a collection of samples, genomic data and health and lifestyle information. It is designed as a living database, registering individuals willing to participate in future medical research. Clinical labour as theorized by Mitchell and Waldby (2010) and Cooper and Waldby (2014) does not envisage the ongoing labour of both participants and BioResource staff in building the basis for continuous involvement. It does not include the “numerous decisions and negotiations that are involved in the everyday work of maintaining (the value of) volunteers” (Wyatt et al. in this issue). A wider or different concept and terminology might be needed to denote what participants do in terms of labour and the source of biovalue, which does not reside in “biological fragments and/or database entries”, but in and through “the ongoing biosocial participation of the willing research volunteer” (*ibid.*).

6. From Biovalue to Biovalues. The Entanglement of Multiple Kinds of Value

In their critique of the notion of biovalue, Birch and Tyfield (2013, 308) argue that charging “the biological” of a value-generative capacity would imply to neglect the role of what they call “bio-values”: “the social or ethical values that make biotechnology a profitable venture” because through them “vitality comes across as a preference (or social value) of individual citizen consumers rather than a new value (or capital) relation”. We take this alleged conflation of social/ethical and economic values as a positive point of departure to examine the complexity of bioeconomic activities. Separating ethical and social values from labour and other political-economic processes suggests that only the latter shape and contribute to the generation of economic biovalue. Ethical and social *biovalues* are thus considered exogenous factors in the economic process, whose unique role is that of providing preferences and demands to meet by the bioeconomy.

To mark what our perspective adds to the literature, we have been using *biovalues* in the plural. This stresses that multiple co-constitutive values (ethical, social and economic) are mobilized in the bioeconomy of biobanking activities. Waldby and Mitchell (2006, 33) recognized that any form of circulation (i.e. tissue economy) is presupposed on and con-

stitutes certain kinds of social and power relations and involves different social values. Other STS scholars have shown how symbolic and strategic values are produced alongside monetary or financial values in biobanking activities (Tupasela 2006; 2016; Tupasela and Snell 2012). Our contribution goes further by proposing a way of accounting for the realization of different *biovalues* and explaining how they are produced in co-constitutive processes. Instead of only looking at how the production of economic biovalue is premised on ethical and social *biovalues*, and how the latter shape the ways in which the former are created and circulate, we argue that the concrete practices of actors involved in biobanking activities are practices of valuing based on multiplex systems of worth and, as such, they at once produce diverse kinds of values.

Recently, Niccolò Tempini introduced a helpful model of the creation of multidimensional values, analysing the online interactions of patients on the social media-based data infrastructure *PatientsLikeMe*. He argues that *business value* and *scientific value* extracted from the data generated by the interactions of patients on the digital platform are not simply accompanied by the *community value* (the creation of communities of people sharing similar conditions) and the *individual value* (medical information obtained and the building of “narratives and interpretations of the self”) but also fostering the latter (Tempini 2017, 196). In his understanding patients’ interactions are not a form of free, clinical labour that generates economic and epistemic values, but also a value in themselves (as producing biosociality, informational and self-identity resources). Moreover, the more economic and epistemic value is generated, the more resources and opportunities for further community and individual values arise. As Tempini points out, there is “a complex convergence of value dimensions at play”, since “different data users are interested in multiple value dimensions at once” (2017, 195-196).

We propose that in biobanks also a plurality of *biovalues* is produced, and that they are co-constitutive of each other. The articles in this Special Issue evidence that the production of economic biovalue does not simply rely on the generation of biosociality and other that make the provision of tissues and bioinformation more legitimate and readily available. Forms of biosocial participation are not simply instrumentalized for the appropriation of economic value, because biosocialities are generated through participation in biobanking activities. This is particularly clearly brought out in Singh’s analysis of diagnostic currency: by donating tissues and bioinformation participants have access to resources to construct identities and relationships, to access services and to solve anxieties related to the respective health conditions. Romero-Bachiller and Santoro show how donating or sharing milk realizes and enforces commitments to the ethical *biovalues* of altruism and solidarity (helping other mothers) and the social *biovalues* in establishing kin-like relationships. Bühler, Barazzetti and Kaufmann’s article also discusses the individual values re-

lated to obtaining medical information and care as well as the social *biovalues* that lie in developing a sense of belonging to a community.

We have argued that multiple *biovalues* are enacted and carry forth the biobanking bioeconomy, and the articles in this Special Issue unfold this conceptual position. The realization of different *biovalues* is integral to biobanking practices. Several kinds of values converge in heterogeneous and hybrid practices of bioeconomic profit and value production. Hybrid economic institutions such as biobanks do not represent any kind of rigid institutional regime of value production. Hybridity, as we argued, blurs the boundary between institutional sectors and economic forms of production and circulation. The production of *biovalues* has to be studied as the outcome of both the entanglement of a very specific banking configuration and the practices of participation and valuing enacted by biobanks staffs, researchers and participants. The co-constitution of social and economic *biovalues* results from the fact that practices of valuing, as argued above, are always dependent on a complex of different systems of worth encompassing moral and social norms as well as economic valuations.

Important to add is, though, that this does not mean that the production of *biovalues* can only be described as *contingent varieties*, in the sense of disallowing generalization or the analysis of what happens in terms of existing theoretical concepts in political economy, sociology and ethics. In this introduction to the empirical articles that follow, we have explained these *contingent varieties* as the outcome of concrete *conditions* for the production of multiple (economic and non-economic) *biovalues*. These conditions are dependent on the particular configurations of patient participation, interactions between staff and participants, design of purpose, and *biovalues* envisaged. As such, the production of *biovalues* is made intelligible and accountable in the different shapes it takes.

Doing this we are not suggesting that forms of exploitation or accumulation by dispossession, driven by profit motives, are not equally important for the growing bioeconomy. We also don't stipulate that exploitative practices involved are counteracted or can be traded off against other *biovalues* like health benefits and a sense of biosocial belonging or citizenship. Shifting the focus on concrete practices, while considering the theories and categories developed in political economy, STS, sociology and bioethics, enables us to explain the shapes of the production of both economic and social *biovalues* in biobanking configurations. Our analytical framework is not limited to re-integrating the analysis of economic biovalue and the reflection on biosociality and identity-building in biobanks. It traces a new path in the analysis of the bioeconomy of biobanks as sites for the simultaneous and interdependent production of multiple *biovalues*. The articles in the Special Issue contribute new and original research to this contemporary critical project.

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