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Connessioni by Fabrice de Nola (2012, Oil and acrylic on canvas, cm 60 x 40. Private collection, Melbourne.)

The Painting is Dead. Long Live the Painting

For a few years and during my various wanderings, I'd been trying out to reflect both poetically and technically on the relations between the image (information) and the picture (object). In 2006 I finally realized the first painting with a QR code, and since 2012 I started to use the Augmented reality (AR). Insert instructions for mobiles in a physical object, such as a painting, corresponded with my vision to make painting that was not isolated from its cross-references.

AR and QR codes use a language that acts as a bridge between the object's physical world and the multimedia sphere of information, favoring a dialogue between old and new technologies and transforming the primitive screen of a painting into a more complex object.

Progressively, my work has been radically transformed, becoming multimedia and participative. As artist, today I feel myself as producer of information architectures. The old technology of painting has persisted as the part of my work, visible in the physical world.

What characterizes the work *Connessioni* is it being a painting made with traditional methods, but working as a multimedia window that contains a text, which in turn contains a video, other images and links.

AR and QR codes enable the painting to extend itself beyond its surface, turning the work in a hypermedia object that nonetheless still remains a painting, in a traditional sense of the term. Also others media included in the process maintain their peculiarities.

The pictorial object is pervaded by information external to its body, while at the same time it is part of it. The painted QR code is addressed to the "Machine". It works as an intermediate media, it is the medium of another media, readable by a device (generally a smartphone). The device has nothing to do with the painting; it is a technological extension of the observer, a mental and sensorial prosthesis, in this case used to fully enjoy a work of art.

The whole forms a distributed, diffuse and reticular imaginary. A small artificial neural network, which structures a discourse about the reality intended as mental and cultural projection, as a human idea manifested in technological phenomena.

Fabrice de Nola

Connessioni was painted in memory of the painter Andrea Di Marco. The chair is a quote from his cycle of paintings *Seduta*. The QR code links to *Lampi*, an open letter to the friends of Andrea.

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Making Kinship Visible through Race in Donor Conception

Lucía Ariza
Instituto de Investigaciones Gino Germani
University of Buenos Aires

Abstract: This article examines 'phenotype matching', a procedure used in Assisted Reproductive Technologies (ARTs) to coordinate the physical appearance of ova donors with that of recipients. Looking into phenotype matching as a socio-technical arrangement, and on the basis of an STS approach, the articles suggests that race is key in making kinship explicit, a making that is particularly important in the case of donor conception. By examining some of the ways in which race enters, and helps to sustain, a regime of visibility whereby family links need to be *made visible* in order to count as such, I make two concatenated claims. First, that race *allows seeing* the differences in bodily colours that may otherwise be too abstract to relate empirically. This making visible of certain features of body contributes, in turn, to the production of race as a material bodily substance. Second, I contend that the avoidance of racial in-coherence between mothers and offspring, which is argued both in 'scientific' and 'social' terms, helps to make kinship visible, that is, to make it real.

Keywords: assisted reproductive technologies; phenotype matching; race; kinship; Argentina.

Corresponding author: Lucía Ariza, Instituto de Investigaciones Gino Germani, University of Buenos Aires, Pte J. E. Uriburu 950, 6to (C1114AAD) Ciudad Autónoma de Buenos Aires, Argentina – Email: lucia.ariza@gmail.com

1. Introduction

In this article I look into 'phenotype matching', a practice used in Argentine ARTs, and elsewhere in the world, to increase the probabilities that children born from donated ova physically resemble their mothers (and, in some cases, also their fathers). On the basis of the epistemologi-

cal and methodological contributions of Science and Technology Studies (STS), I use ethnographic accounts of clinical work to explore how the fertility clinic attempts to reproduce physical likeness materially and semiotically. I claim that although its necessity is rarely argued for in racial terms, the matching of egg donors' and recipients' physical appearance is primarily concerned with achieving racial coherence, supporting Wade's (2012a) suggestion of an expected 'race-kinship congruity' between parents and offspring. In this article, I suggest that producing resemblance in Argentina is rarely (if ever) solely about the replication of distinguishing visible traits, like the size of the ears or the shape of the eyebrows. Rather, it is about creating children who look like their parents in racial terms, about keeping to a family both biologically and culturally. I argue, further, that this 'keeping to' is also, in the context of the stigma still attached to the use of donor gametes, a form of 'keeping up appearances', not merely of belonging to a given family group, but more specifically of belonging to it in a biological way. In Argentina, appearances, and their centrality for both folk and scientific reckonings of race, help to sustain a socially relevant fiction: that children born from donated gametes are the biological offspring of their mothers. Building on Marilyn Strathern's (1992) suggestion that making family links *explicit* plays a crucial role in making (English) kinship real, I suggest that racial congruity between progenitors and donor children contributes to the realness of (Argentine ART's) kinship by allowing it to be seen. In examining some of the ways in which race and kinship materialise in the actual clinical making of mother/donor children similarity, the article contributes to a consideration of their materiality, their entrenchment in technoscientific practice, and how the latter displace the former as biological 'facts', evidencing – what may have been theirs all along – enacted character (M'charek 2010a, 2013; Ossorio 2006; Szkupinski Quiroga 2007; Wade 2002; 2012a).

The matching of physical appearance for donor children is an established routine in ART practice in Argentina and around the world[1]. It

[1] Countries that currently have legal and/or bioethical provisions regarding the matching of donor and recipient(s)' phenotypes include Spain, the US and the UK, among others. The Spanish law on human assisted reproduction techniques, which does not mention which traits are to be matched, states for the case of sperm donation that 'Under no circumstances will the [male] donor be selected by request of the [female] recipient. The medical team will ensure the *greatest possible phenotypic and immunological resemblance of the available samples with the female recipient*' (Law 14/2006, Chapter 2, Article 6, Paragraph 4, accessed online 10 June 2010, my translation, my emphasis). In the US, the American Society for Reproductive Medicine (ASRM) and the Society for Assisted Reproductive Technologies (SART) Guidelines for Gamete and Embryo Donation (2008) also refer – again, only for the case of sperm donation – to matching of donor and male recipients' characteristics, although overall they are much less constrictive than the Spanish case, indicating that 'The couple *should be encouraged to list the characteristics that they desire* in a prospective donor, including race and/or ethnic

consists of the classification and matching of some physical features of the gamete donor with some of those of the gamete recipient, these features being eminently observable in accordance with what in scientific parlance is defined as phenotypic. Characteristics that are usually matched include eye, hair and skin colour, blood type and Rh factor, ethnic background and height, among others[2]. In Argentina, the matching is always carried out by a practitioner, yet depending on the centre, patients may or may not be consulted regarding their willingness to accept a donor with certain given physical features. The identity of both donor and recipient is always kept anonymous by the centre.

Argentina is also a country of immigration like the US and the UK, and to a certain extent Spain, as examples of three places where physical coordinations also take place. Its main population intakes were Spanish, Italian and to lesser degree French immigrants, as well as a smaller number of other Europeans, who by the first fifteen years of the 20th century had given Argentina a third of its population. The ubiquity of immigrant population in Argentina and Buenos Aires, especially at a moment of political consolidation and economic expansion as Argentina became globally known as the 'granary of the world', helped to sustain local narratives of the 'Europeanness' of Argentina's population (Rodriguez 2011). As Andrew Lakoff (2005, 6) has noted, this trope is one that made members of the Argentine elites and middle class see themselves as "Europeans in exile". Ideas of this kind have pervaded commonplace discourse about the origins of Argentine and Buenos Aires's population, in part due to the continual economic and cultural subjugation of native Indigenous groups, and the relative invisibility of other immigrant parties of considerable numerical importance (mainly Middle Eastern), and it is even today that

group, height, body build, complexion, eye colour, and hair colour and texture' (ASRM/SART 2008, S36, my emphasis). In the case of the UK, traits that were to be matched were never detailed in the regulation. The HFEA's Code of Practice 6th Edition (2003) stated that 'Where treatment is provided for a man and woman together, centres should strive as far as possible to match the physical characteristics and ethnic background of the donor to those of the infertile partner (or in the case of embryo donation, to both partners) unless there are good reasons for departing from this (...) those seeking treatment are expected not to be treated with gametes provided by a donor of different physical characteristics unless there are compelling reasons for doing so' (HFEA 2003, 32-33). This phrasing was already a change from the one used in the previous version of the Code (2002), where clinics were advised not to give patients gametes from persons of a different racial origin (Wade 2012a). Notably, recommendations concerning phenotype matching were dropped from the 7th Edition of the Code of Practice (2007), a change that may be linked to the attempt at 'publicly avoid[ing] policies that might smack of eugenics', as Wade (2012a, 86) suggests.

[2] In addition to these, one sperm bank in Buenos Aires lists 'physical type', 'hair type' and 'ancestry' (Cryobank. (2014), Por qué Cryobank, in http://www.-cryobank.com.ar/index.php/por-que-cryobank#tabs-3 (retrieved July 22, 2014).

Argentines identify themselves as of largely European origin.

The facts above help to illuminate the wider rationalities at work in the carrying out of physical coordinations as part of the use of donor gametes in Argentina. They frame the enactment of race as part of the material production of kinship and filiation. I will begin the article by providing a brief account of previous contributions from the scholarship on kinship and ARTs that contextualise the study of the clinical production of physical resemblance. I also offer some examples of how medicine has historically categorised human phenotypic traits, including the use of racial categories in medicine and beyond. After concisely describing the main technical steps involved in producing similar phenotypes, the first analytical section of the article examines ethnographic accounts of the use of phenotypic data forms where the physical data of egg donors and recipients is recorded. Suggesting that phenotype matching can be understood as an inscription device (Latour and Woolgar 1986), I analyse how the data form helps to formalise the differences between, and thus mutually detach, the empirical variance of physical traits (i.e. the several colours of human skin). This formalisation demands particular kinds of colour racialisation[3] that entail enacting 'race' within medical practice, an enactment which is significant in the light of the lack of a known scientific basis for the existence of human races (Banton 2012; Ossorio 2006). Basing my argument on these considerations, and expanding Strathern's (1992, 52) "equation between what is seen, what is real and what is natural", I suggest that phenotype matching is a device whereby race helps to make body colours visible, race in turn being made real as a material body substance. This arrangement helps to sustain the socially relevant fiction of the biological connection of mothers and offspring, while also performatively (and normatively) shaping the materiality of babies' bodies in ways that make them embody racial differentiation.

On the basis of scientific argumentations regarding the need to realise physical coordination between donors and recipients, I offer in the second section further examples of the ways in which race is implicated in the production of resemblance between mothers and offspring, an implication that is particularly visible in the case of patients with white phenotypes. Exploring how the search for racial coherence is argued in scientific terms while race provides a telling example of the ways in which nature works, I show that race is not only enacted as a biological aspect of human life (as may be expected from a medical milieu primarily concerned with the body), but also as a social one. Again following Strathern's lead, I contend that this alignment of scientific and racial thinking entails making (white) kinship real by way of avoiding racial incoherence, that is, by making racial coherence visible. Finally, I suggest as a future line of enquiry that the conflation of race and science may in-

[3] By 'racialisation' I mean the classification of people according to racial categories, although I do not necessarily imply a form of hierarchical classification.

volve the protection of white against brown or black, which in the Argentine and more widely Latin American contexts are still carriers of stigma and confer fewer social advantages.

2. What's in a face? The links between phenotype, race and kinship

It is a long established fact in the field of studies of kinship that Western ideas of familiar relatedness involve notions of things transmitted through 'nature', paradigmatically blood and genes, while these biological connections are frequently socially re-deployed in ways that sometimes replicate them, and sometimes complicate them, making them a set feature of kinship and yet a not straightforwardly accountable one. For example, Schneider (1968) claimed that kinship in the US was understood to be genetically based, yet he also underscored in later analyses the extent to which biogenetic ties were being submitted to the logic of choice (Schneider 1984). Similarly, Jeanette Edwards (2000) accounted for the ways in which people in a town in northern England conceived themselves as both being 'born' and 'bred', linked through descent but also through culture, by the fact of having grown up with others in a certain place. And relying on Strathern's (1992) concept of "merographic connection"[4], Sarah Franklin has suggested that the new genetics work by assembling parts (like the natural and the social) which, belonging to different wholes, "instrumentalizes [...] the model of kinship that says it is part of biological process and part of society" (2003, 82).

The above-mentioned contributions have been important in problematising kinship as something that is not simply a social construction of natural facts, and as something which incorporates, in variable ways, 'nature'. Once these contributions established the importance of biological links for Western kinship, Becker and colleagues (2005) focused on testimonies of families constituted through donated gametes. They employed the term 'resemblance talk' to signal how commonplace 'chit chat' about parent-offspring resemblance illustrates how "the normative folk model of kinship in the US attaches great significance to genetic or 'blood' relationships" (2005, 1301). In its apparent banal significance, talk about children's appearance is constitutive of the parent-child relationship, producing filiation by phenotypically relating babies to their progenitors. Yet as Becker and colleagues make clear, 'resemblance talk' can also be a fairly destabilising moment for donor children's families in the sense that, if physical continuity is not clear, connections through informal talk are more difficult to establish.

[4] Strathern (1992) defines a connection as 'merographic' when the parts that come together partake simultaneously of other 'wholes'; this is, a merographic connection is one which only engages parts partially.

The issue of parent-children phenotypic resemblance has also been addressed in the case of other family forms like those of lesbian partners (Nordqvist 2010) and those with adopted children (Carsten 2000). In the case of heterosexual couples, however, physical resemblance is a highly anticipated result of conception (arguably more than in the cases mentioned above), and provided that children look reasonably similar to their parents, the fact that they were conceived with donated gametes becomes less obvious. In Argentina in particular, parent-offspring physical resemblance is a fixed feature of everyday 'chit chat' over young children, and when a child does not resemble their heterosexual parents (especially the father) the fact is usually pointed out through colloquial and idiomatic jokes alluding to a the mother's infidelity. Biological parenthood and biogenetic kinship are still the preferred means of family constitution (Garay 2008; Tarducci 2008), and while ARTs have successfully positioned themselves as the great means for achieving these goals for those who can afford the expensive treatment, donor conception is still stigmatised and usually kept secret beyond the family nucleus. In this context, as Becker and colleagues pinpoint, heterosexual parents forming families with the help of donor gametes usually feel that resemblance talk "may cast doubt on the legitimacy of the family structure and subject family members to stigma" (2005, 1301). This situation affects the ways in which race-kinship congruity is sought about in Argentina.

Through the notion of 'resemblance talk' and the menace it might pose for family cohesion and constitution, Becker and colleagues' contribution helps to emphasise just how much phenotypic appearance is taken to be a 'proof' of a biological connection, and thus a key locus of kinship enactment (insofar as the signalling of the presence or absence of the former qualifies the latter). Their findings can also be thought as a particular case of the broader account by Marilyn Strathern. The author has pointed out that tracing natural ties is part of everyday kinship-making in England, emphasising how the naturalness of relations is not given but rather needs to be made explicit. She further observes that, in English kinship, "if something [like biological connection] (...) is seen, it is real" (1992, 52).

The scholarship above is useful in highlighting the importance of physical appearance for an understanding of kinship and of kinship-doing in the fertility clinic. None of these contributions has, however, focused on the articulation of kinship and race, a point that has been tackled by Peter Wade and Seline Szkupinski Quiroga. Discussing racial thinking, Wade asserts that it "is thinking about appearance, inherited substance and behaviour in relation to specific categories which emerge out of colonialism" (Wade 2012a, 80). Specifically on the relation of kinship and race, Wade has suggested that "[k]inship is important in order to understand race because racial identities imply notions of inheritance, both 'natural' and 'cultural', for which the most crucial means of transmission is the family, at least in Euro-American kinship" (2012a, 80). In a more

critical fashion, Szkupinski Quiroga (2007, 144) has argued that "ARTs's privileging of genetic relatedness is currently deployed in ways that support a white heteropatriarchal model of family in which race and whiteness are reified as inheritable", signalling how ARTs' promotion of biogenetic ties entails the enactment of racialised models of kinship that seek to reproduce the white nuclear family; a process underpinned by expectations of racial purity.

This article explores how race is part of the material enactment of physical likeness between mothers and donor children in the Argentine fertility clinic. In order to do so, it draws upon the above-mentioned contributions, which have underlined how 'resemblance talk' contributes to enacting kinship as a form of biological continuity, as shown by Becker and colleagues; how the 'real-ness' of family ties depends on them being 'seen', that is, on being visible, as suggested by Strathern; and how race and kinship cannot be thought of separately in the context of a study of ARTs, insofar as in the West both tend to pass as biologically given, are paradigmatically noticed in physical appearance, yet need also to be understood in their technologically 'constructed' character. In this, the article takes as a structuring assumption the acknowledgement that race is not inscribed in genes (see M'charek 2010a; Ossorio 2006), but rather that this is often the performative result of discursive and material constructs, including scientific and prosaic technologies, that gradually sediment such effect.

3. Race in medicine and beyond

As mentioned above, the characteristics that are matched during the phenotype co-ordinations concern a selected set of aspects observable in a person's appearance. From a historical perspective, it is clear that their very selection and stabilisation through time as features of medical attention is the result of a long history of practices concerned with classifying bodies according to their visible differences. This history intermixes with that of racial categories, itself the result of specific political and economic contexts, particularly of colonialism, which have grouped people in a limited number of collectives, usually termed Africans, Europeans, Native Americans, Asians, Australasians (Wade 2012a), or similar. As has been widely noted, such categorisations have underpinned many political projects of reformation, segregation, intervention but also of visibilisation of particular human collectives that have been promoted by interest groups as diverse as the criminologists and eugenicists of the 19th and beginning of 20th century, and by genomic research actors and institutions, and pharmaceutical companies more recently.

Indeed, colonial medicine relied heavily on racial categorisations that guided its interventions in dominated territories. In the Latin American

case, as has been documented, for example, by Nancy Stepan (2001), 19th century 'tropical medicine' sought to classify the human diversity it encountered, while deploying that very classification in recommendations for improvement of dark bodies' susceptibility to disease. Yet as Rodriguez (2011, 423) points out, racial categorisations cannot be separated from the "creation of stigma and racialised ideas about people from hot climates". The use of classificatory regimes in medicine and politics, and their racialising effects, has indeed been well analysed in studies of eugenic movements in Latin America. Stepan (1991) argues that, in Latin America, a neo-Lamarckist version of eugenics that was more politically resonant than its opponent, the Weismann-Mendelian view of heredity[5], deployed notions of 'race' and 'pure blood' that guided eugenic interventions in the social, with the expectation that such reforms would translate in permanent improvement, and therefore evolution, of these countries' populations.

As it is well known, it was not until the end of World War II that the political (ab)uses of race were explicitly countered in the arena of international politics by UNESCO's two documents on race (1950, 1951). While the two groups of experts that participated in the discussions that led to the publication of both documents found it difficult to arrive at a consensus on the definition of 'race'[6], the debates that took place resulted in 'population' becoming the preferred category for use in biological research, while 'race' was "allocated to the domain of 'ideology' and 'bad science'" (M'charek 2008, 524).

Yet despite UNESCO's statements and the relative disappearance of 'race' from the design of medical research for a few decades, recent years have seen a re-emergence of interest in 'race' and human genetic variation in medical and scientific discourse. In fact, as noted by M'charek (2008, 524) "race is making a vital comeback in various branches of genetic research". A paradigmatic example of this was the Human Genome Diversity Project (HGDP), which in its effort to map the genome of so-called disappearing populations, redeployed notions of race even in the face of worldwide scientific consensus regarding its biological meaninglessness (M'charek 2008, 2010b; Reardon 2004). Another notable example of this resurgence is that of forensic technologies, which have been directed towards identifying the genetic basis for traits like skin, hair and iris colour, genetic ancestry and genealogy, in order to be able to use them in crimi-

[5] While the first conceived inheritable qualities as affected by environmental changes, the second one thought of heredity as located exclusively in the germ cells, that is, as made possible only by mechanisms internal to the body, rather than external to it (Stepan, 1991).

[6] While the participants of the discussions that led to the first document were mainly sociologists and anthropologists, the heavy criticism met by its publication entailed the participation of experts coming from the biological and medical sciences in the discussions which led towards the second document.

nal investigations. Of special interest to this article is forensic research aimed at linking DNA with facial shapes and other externally visible characteristics (Ossorio 2006). Such technologies, promoted in countries like the UK and the Netherlands, have sought to produce a 'partial physical profile' out of the biological evidence left at a crime scene (M'charek 2008). Interestingly, as is wisely pointed out by M'charek, despite their experimental character these technologies have not only been rapidly accompanied by legal developments, but at least in the Dutch case, were actually *anticipated* by the legislator[7]. These uses and imaginaries of the power of technologies point in the direction of legal and scientific understandings of race as a biological and visible quality, inferable from appearance and genetically given, resonating with some of this article's findings.

A third example of the renewed interest in race in medicine is provided by the pharmaceutical industry. As has been well documented, in 2005 a 'race-specific' drug (BiDil) to treat and prevent heart failure was approved by the US's Federal Drug Administration. Although the clinical trials that led to its approval were not properly designed to compare the effectiveness of the drug in different populations (Duster 2007), the drug was granted a patent that allowed it to be targeted specifically at 'African-Americans', claiming an increased efficacy on this population as opposed to the white one. Nevertheless, the biological mechanisms that underpinned such differences could not be explained (Inda 2014). More worryingly, the trials that led to the drug's approval lacked any substantial definition of how 'race' was understood and deployed in them (Coons 2009), ultimately contributing to both deleting the socio-demographical factors that could explain predisposition to heart failure in different populations, and to promoting a view of racial difference as grounded in biology (Coons 2009; Duster 2007; Winickoff and Obasogie 2008). Although the granting of the patent has been substantially criticised by both social and medical actors for, among other reasons, overstating the therapeutic significance of race (due ultimately to economic incentives), arguments in favour of the use of race in medicine have been made for a long time and still are today (González Burchard et al. 2003; Hunt et al. 2013).

Importantly, in all these examples it is always the same old classificatory regime that is being deployed (Rabinow and Rose 2006), whereby so-called 'racial' traits are being deduced from people's phenotypic aspect or self-ascription (Hunt et al. 2013; Reardon 2004). Rather than producing a

[7] As early as 1994 the Netherlands passed regulation permitting the use of body samples for criminal investigations irrespective of the suspects' willingness to contribute such samples. This legislation was successively amended in 2001 and 2003. The second change included "the inference of 'visible external personal characteristics' from biological samples" (M'charek 2008, 522-523). Here, physical traits were defined as 'overtly visible to anybody', while 'race' was comprised among such 'externally visible traits' (2008, 523).

'new complexity', Rabinow and Rose note, for the case of the HGDP and other projects that seek to map the variability of the human genome, the repetition of "the core racial typology of the nineteenth century's – white (Caucasian), black (African), yellow (Asian), red (Native North-American)" (2006, 207). The implication is that increasingly advanced technologies are being instrumented through the old classifications, now re-directed by the use of molecular technologies in forensic and pharmaceutical research, while also re-deployed in contemporary (post) disciplinary constructs aimed at identifying persons and regulating their circulation.

4. Methodology

This article presents results from an STS examination of Argentine ARTs. In the wake of critiques of technoscience regarding nature's loss of its *a priori* value "as referent or authority" (Franklin 2000, 190), the progressive erosion of its ontological difference from culture (Haraway 1997; Rheinberger 2000), and the fact that nature is increasingly modelled on culture (Rabinow 1992), the study sought to establish if and how nature could be said to be (still) present in the practices of fertility medicine. Thirty-five interviews were carried out with ART experts and researchers, which included practitioners of gynaecology, embryology, genetics, psychology and psychoanalysis, biology, endoscopy, endocrinology and nursery. Three of these interviews were held with fertility researchers (biologists) working at research institutions rather than fertility clinics, while the rest of the interviewees worked or had worked at centres offering ART services.

Contact with the practitioners was made through a network of mutual referral ('snowball' technique), and the interviews were usually carried out at the clinics. The interviews covered a wide variety of topics related to ART practice. The excerpts cited in this article correspond to a smaller subgroup of ten interviews in which phenotype matching was discussed with the practitioners. The research sought ethical approval from the Ethics Committee of the Department of Sociology at Goldsmiths, University of London. All the participants expressed consent to their participation in the study by signing an informed consent form.

Held within an STS-grounded research, the interviews sought to recover ethnographic information regarding clinical practice, including practitioners' daily routines and their use of technological equipment and medical-administrative devices (discussed below). Understood as a material engagement of humans and devices, medical work was conceived from the outset not as a matter of 'ideologies' or 'ethics' that could be separated from concrete practice (see Mol 2002). Interviews did not focus exclusively on trying to understand how practitioners *thought* about their

work, but above all on how they *worked*. Participants were asked to talk about specific aspects of their daily practices, and attention was paid during the meetings to descriptions of how they related to the medical setting, their use of equipment and bureaucratic apparatuses, and the interaction between different types of knowledge inside the fertility clinic, such as gynaecology, andrology, psychology, biology and genetics.

In line with this approach, the study also entailed the collection of a series of materials that circulate ubiquitously within the fertility centres and between the experts involved. These included brochures, information leaflets and documents, medical and ethical guidelines, pieces of legislation, informed consent forms, transcripts of parliamentary debates, photographs, phenotypic data forms, diagrams, medical papers, and information and advertisement pieces present at the clinics' websites. The STS approach taken here favoured the inclusion and analytical consideration of such materials, and facilitated a focus on *agencements* (Deleuze and Guattari 2002), or occasions of mutual engagement between humans and devices whose joint production is greater than the parts (Phillips 2006). The phenotype matching analysed here is an example of such interaction.

Insofar as the project sought to promote the analytical inclusion of other-than-human entities, which also participate in the clinic, analysis of the interviews was not focused on unearthing 'deep meanings' from the interviewees' accounts. Rather, the analytical focus was on identifying noteworthy moments of engagement between human and apparatuses, and where symbolic signification, enabled by language, was not the sole agential dynamics. This methodological premise is seconded in analytic terms in the present article: while race is not the linguistic matter of the search for phenotypic resemblance (mother/child physical coherence is rarely described in terms of a racial issue in clinics' institutional discourse), the analyses show, however, that race is indeed implicated in the making of physical resemblance, albeit in material, less linguistically-explicit ways, done immanently without this making being actually 'said'. Throughout the article, this material and semiotic 'doing' of race (and kinship) is captured by terms like 'performation' (Callon 2007) and enactment (see Law 2004; Mol 2002), which refer to how things are made in practice in ways that encompass both linguistic and extra-linguistic activities and objects, involving many forms of human-nonhuman entangling.

5. Seeing through race

In Argentine fertility clinics, 'race' is scarcely talked about during discussions of making resemblance, a fact that is manifested, for example, in the absence of racial categories from core clinical devices like the data form analysed here. The search for physical similarity is usually justified, rather, in terms of the importance of good mother-donor child bonding,

the stigma still associated with the use of donor gametes (both because a monetary exchange is involved, and because it entails not being able to reproduce with one's own gametes), and the concomitant need to reduce possible sources of detachment or lack of connection between mothers and donor offspring. Appearance, kinship, and sometimes beauty, are always at the front: the emphasis is on how children born through medical procedures, including donor children, resemble their parents in a generic – not explicitly racial – way. A doctor said, for example:

> 'Sometimes they bring us photos of egg donation babies and you say 'wow, they are beautiful'. They are beautiful, beautiful, beautiful, and *even similar to their parents, I don't know if it's the intention that you see them similar...*' (Gynaecologist 2, my emphasis)

The presence of kinship – and the absence of race – in discussions of phenotypic similarity between donor children and their parents are also frequently echoed in clinics' institutional discourse. On their website, where information on egg donation is provided, a centre explains, for example:

> 'How is the donor assigned to the recipient couple? The egg donation team (....) carries out an artisanal job in assigning the donors, based on the detailed observation of the physical appearance of the donor and the recipient couple (height, weight, eye and hair colour, complexion) and blood type compatibility' (Clinic website excerpt)

As the examples above make it possible to see, 'race' is not the discursive matter of resemblance in Argentina, at least not until questions about race are asked explicitly by the researcher. The issue of similarity, and how its potential lack is actually made up for through clinical procedures, is talked about in terms of morphology, of the similarity of isolated traits, almost always with no reference to how such traits might actually socially code for race. In the following I will argue, however, that although race is almost entirely absent from the more explicit and intentionally directed medical statements on the issue of resemblance, the *actual clinical doing* of similarity is indeed concerned with race, in often 'silent' less, explicit ways.

To show this, in this section I will examine the use of 'phenotypic data forms' by fertility practitioners. Phenotypic data forms are a simple tool for inventorying a selected set of aspects regarding donors' and recipients' appearance; a record of their look at a particular point in time, used to aid practitioners in remembering a set of characteristics. Some of the clinics will usually match the donor first with the woman who will receive the egg, and will in a second instance try to select a donor who has 'something' of the partner, for example a so-called 'secondary trait', like the shape of the eyes. However, other clinics will not match with the partner of the egg recipient at all. The phenotypic data form is generally used on-

ly in the case of recipients, while information about the partners will be recorded in less systematic ways, for example by 'making a note', or simply by remembering it. Some centres use forms both for donors and recipients, while some others use them only for donors or only for recipients[8]. The form analysed in this section is organised as a series of headlines, each headline corresponding to one physical feature (i.e. hair), followed by a series of options (i.e. black, brown, blond, red) beside a checkbox. Using the form, the practitioner will choose from this list the answers that best describe the way a person looks.

The categories contained in the form are meant to operate, then, as descriptors of physical characteristics that can help the practitioner obtain a rapid, and easily recoverable, register (for example, when the donor or recipient are no longer physically present in front of the practitioner). In a sense, forms are structured upon the premise that phenotypic traits are *observable* and *measurable*, much in the way in which Michael Banton (2012) argued, for example, in favour of skin colour as a more objective criterion than 'race' in acknowledging human difference. In fact, 'race' might appear to be less objective than bodily traits, like skin colour, for the medical gaze, which may be the reason for the avoidance of racial categories in the phenotypic data form. However, as the next paragraphs will show, colours and other traits can be hardly disentangled from race even in a scientific, supposedly 'social-free', context (for a discussion, see Fox 2012; Martiniello 2012; Telles 2012; van den Berghe 2012; Wade 2012b). On the basis of the information that they record, the forms will afterwards be used to assign a particular donor to a particular recipient.

Phenotypic data forms can also be characterised as an apparatus contained in an inscription device (Latour and Woolgar 1986), while the matching as a whole can be identified as an example of the latter. According to its famous definition, an inscription device is "any kind of apparatus [...] which can transform a material substance into a figure or diagram [...] directly usable by one of the members of the office space" (Latour and Woolgar 1986, 51). Yet key to the definition of an inscription device is not only its capacity for *transforming* a 'material substance', but also for *bracketing off* such a transformation, this is, the ability to present its product as *the substance itself*. In what follows, I will argue that both characteristics (transformation and bracketing off) are present in the clinical arrangement that engages the work of phenotypic data forms and medical practitioners.

As was observed above, the phenotypic data form is a device used to record the way persons look, with the aim of facilitating the matching of donors with recipients. Simple as the procedure of registering a person's appearance may seem (the banal act of looking with some attention at how a person 'looks' and checking off categories on a form), it implies

[8] Unfortunately, due to a lack of space I cannot give a detailed explanation nor make sense of these different arrangements here.

several forms of knowledge and several translations that may not be immediately evident. In fact, relying on pre-designed forms to perform physical coordinations may not be at all a simple endeavour, if 'simple' is to be understood as an activity with no mediation. I ask one of my interviewees responsible for assigning donors to recipients at one clinic how does she actually carry out the donor/recipient matching. She answers that not all characteristics are equally important, insofar as complexion colour is more important than hair and eye colour, pointing for the first time to the significance that skin colour has for kin – and, I will argue, racial – reckoning in Argentina (see also Telles 2012; van den Berghe 2012). With regard to skin colour, she tells me that the phenotypic data form she uses classifies four categories: white, matt[9], light brown[10] and dark brown. Curious about how is she able to recognise such differences, since I am not myself so sure of being able to do so, I ask her how she chooses between these options:

> LA: And which are the categories of the skin? How do you *divide* them?
>
> G: white complexion...
>
> LA: what would that be?
>
> G: *us*. White complexion, matt complexion, light brown and dark brown...
>
> LA: aha, there are a lot...
>
> G: yes, brown I *divide* into two, light brown would be for example a Latino, and dark brown would be an African. *In a certain sense, that is the idea that I have of it*. But the skin is brown...
>
> LA: and what would matt be?
>
> G: matt is something in between a Latino *and us. Is it that kind of skin that, when exposed to the sun, becomes golden. I become red*. The one that becomes golden. It's that skin (Gynaecologist 2, my emphasis).

Similarly, I asked another practitioner:

> LA: Which are the categories present on the form?
>
> N: white, brown, very brown and black
>
> LA: and is it easy to distinguish between them? How do you use them?
>
> N: well, it's difficult... yes, it is a bit subjective. Did you see my colleague that just entered into the room? I think she would be brown (Nurse 1)

Much as many would want it that way (see Banton 2012), skin colour

[9] In Argentine Spanish, 'mate' (matt, matte) may be used as a colour to describe a shade of brown, although, as it is characteristically imprecise, what shade exactly the colour matt refers to is very difficult to establish.

[10] The practitioner uses the term 'moreno' which might be better translated as 'dark', yet I have chosen to translate into 'brown' to be able to qualify it as either 'light' or 'dark'.

differences are not self-evident or bodily inscribed; they are produced in technical (Latour 2002) or sociotechnical (Callon 2007, 2010)[11] arrangements that make them both graspable, real and, as M'charek (2010a) suggests, relational. In effect, both practitioners' explanations of how they actually use the form show that – to be able to *empirically see the differences* between categories – they rely heavily on their experience as a person, a member of a wider social group and not strictly of the medical profession, to understand and deploy the categories given on the form. To function as entities with meaning, formal classifications like white, matt, light brown and dark brown need to be inscribed in/through a sociotechnical arrangement whereby they are racialised ('light brown [is ...] a Latino'). They become understandable by way of being read as markers of racial identity, making race real (Strathern 1992) insofar as it can actually be *seen* in people's bodies. This process can further be understood as the deployment of a form of racial thinking amid scientific practices, and whereby the existence of racial differences that cannot be proven through science (Hunt et al. 2013, Ossorio 2006) is paradoxically reinstated through scientific practices.

What does the above tell us about the use of the phenotypic data form in the clinic? I argue that it is a potent example of how race becomes a key element in the rendering of empirical colour differences, and thus in the making of family resemblance. In effect, the categories present on the form are not capable *by themselves* of providing a definitive and uncontroversial reckoning of a person's look. Formal as they are, deprived of quality or examples, the colour divisions demand that they are 'agenced' (Deleuze and Guattari 2002) with the practitioner. This agencement entails their being made sense of according to some classificatory system. This classificatory system is race, which is further actualised by the arrangement in which phenotypes are matched. But why is this so?

The answer lies in what the form represents in the context of its use in Argentine ART practice. In fact, forms are an abstraction of data which appears in a continuum in a population; a continuum that, for example in the case of complexion, covers the infinite colour gradation between 'white' and 'black'[12] (see also Fox 2012). Yet because the form's purpose is in a sense to enable 'recordability', speed up the matching process and reduce the empirical complexity of a person's phenotype, it relies on specific losses of information, precisely those related to the continuum of colours (Ariza 2014). It is in this sense that forms can be understood as a

[11] Following these authors, I characterise the arrangement in which form and practitioner are engaged as technical or socio-technical precisely because it relies on an interaction between humans and apparatuses.

[12] I do not dwell here on the conventional character of terms like 'white' or 'black' to describe the colour of human skin. I point out, however, how such convention may partake of the formal (abstract) character of the colours on the form that I am analysing here.

categorisation, a representation of information through division and differentiation. Forms enable, hence, the formalisation of skin colour difference; they have a performative character in that they contribute to perform such distinctions (for a similar argument on colour scales, see Fox 2012). Yet given the colour continuum in a population, the difference that the form produces is a kind of abstract difference, ultimately hard to identify unless related empirically.

According to the above, the form records in a highly abstract way a person's physical appearance, divesting her appearance of singularity (the specific position in the population colour scale, shapes, etc.) and converting it into a specified abstract, the particular combination of general and repeatable qualities. Thus, insofar as the categories on the form are abstract, generic forms that summarise a set of traits but in no way the singularity of a person, those categories need to be interpreted, related to the broader, more-than-medical experience of the practitioner, in order to be deployable during the matching process. As suggested above, 'race' is a key element in the translation that takes place between the abstract categories of the form and their actual use in the clinic. Race is a system that allows the formal colour differentiation of the form to be found empirically, literally by being seen through race.

Moreover, this seeing entails the *making* and reinforcing of racial difference as 'material substance', a process that is, however, scarcely evident, that is, bracketed off, as if people were indeed racially differentiated *in nature*. In fact, because the making of difference is enabled through a sociotechnical arrangement designed to register *bodily* differences, race is enacted as a fact of nature, further working as a reinforcement of Western notions of kinship being in part biological (Edwards 2000; Scheneider 1984; Strathern 1992; Wade 2012a). By helping to establish differences between people on the basis of their phenotypic appearance, the arrangement in which both the form and the practitioner interact produces 'white [as] us' and 'light brown [as] a Latino', that is, race as the given matter of bodies whose 'coherence' is only retrospectively sought out. This performation also entails the (re)production of bodily colour difference between people as a characteristic of the Argentine population. By producing family colour coherence as part of the production of kinship links and filiation, the population as a collective body is enacted as defined by difference and neatly discriminated divisions that speak of distinct kinds of people.

6. Scientific arguing, racial doing

As shown above, the production of physical likeness between mothers and donor children in Argentina entails the racialisation of body colours; a process whereby race makes possible the matching of phenotypes, and

becomes produced as a material substance ineluctably inscribed in bodies. In the following pages I give different examples of the ways in which race is implicated in the making of resemblance. I suggest that while in the Argentine fertility clinic the necessity of phenotypic (racial) coherence is argued in scientific terms, race provides a telling example of the ways in which nature works. This mutual emergence of race and science (as a discourse on nature) entails the making real of kinship by way of avoiding racial in-coherence, that is, by making racial coherence visible. This reinstates classical Euro-American understandings of race and kinship as partly biological and partly social (Edwards 2000; Schneider 1984; Strathern 1992), further proving the embedding of science in the social (see Latour 1993). Continuing our discussion of her daily matching routine, the issue of body colour reappears in our talk with one of the practitioners. I ask her who taught her how to look at the donor, since I gather her job requires a lot of attention to detail. She clarifies:

> G: at the donor and *at the recipient. Because maybe the recipient doesn't ask for her donor to have white skin, but you see that the recipient is of this colour* [points to the colour of her own skin] *and you say 'I can't assign a donor with brown skin to this recipient'*. So then (...) I *make a note somewhere* that she [the recipient] is very fair, so that I know when the assignation time comes that I can't give her a dark donor...
>
> LA: so even if you are not asked to, you do it...
>
> G: yes, *it is a matter of logic* (Gynaecologist 2, my emphasis).

By arguing in terms of (lack or presence of) 'logic', the practitioner denies here the possibility of assigning a donor with brown skin to a fair-skinned recipient. She appears to imply that assigning together two persons of different colours (and in that sense, not matching at all) will give out – or increase the possibilities of giving out – an unwanted result: the 'wrong' colour in the offspring. Similarly, another doctor answered:

> LA: Do you think that the matching is important?
>
> G: I think it's important (...) for a *social reason*, and that is the thousand-year-old *separation between Whites and Blacks* (...) *you can't give two very blond persons the ova from a dark-skinned*[13] *donor because they will have a dark-skinned son* (Gynaecologist 1, my emphasis).

What is implied in these clarifications? What is the 'logic' that needs to be clinically upheld? I argue that the practitioners' explanations are

[13] The word used by the practitioner to refer to people of dark skin is 'Morochona', in this case a superlative of the Spanish word for brunette or dark, morocha. As with the diminutive case below ('morochita'), the use of a superlative is indicative of the attempt to introduce a further connotation into the original word, probably to dilute the possible negative connotation of making a differentiation between those who are morochos and those who are of white skin.

indicative of a conflation between forms of racial and scientific reasoning where race and science are aligned and made to support each other. Furthermore, I suggest as a future line of enquiry that this alignment appears particularly important in the case of patients with white phenotypes, and in the context of a lower frequency of 'mixed' couples in comparison with 'colour-coherent' sexual partnerships.

Regarding my first claim, in effect, both practitioners' answers above are significantly structured around the imperative 'I/You can´t [assign a Black donor to a White recipient]', a form of argumentation that is indicative of the ways in which race emerges as a classificatory system that reinforces the clinical upholding of natural laws, while the necessity of racial coherence is argued in scientific terms. On the one hand, as both quotations illustrate, from a scientific point of view it lacks 'logic' to assign a dark-skinned donor to a White recipient because 'they will have a dark-skinned son', an unlikely result unless the partner of the woman is of dark skin (I dwell on the significance of the hypothetical assumption regarding the Whiteness of the partner in the paragraphs below). This lack of logic appears to be argued on the basis of what is thought to be the genetic law of the recessiveness of certain traits: genetically speaking, dark eye and hair colour are considered to be dominant over blondness and blue eyes. Hence, while the inheritance of a trait like skin colour is a complex genetic process that entails the interplay between several genes and proteins, and not just one gene, this complexity appears simplified in the practitioners' accounts. Justified in terms of the dominance/recessiveness logic, the refusal to attribute dark to white has more predictable results, ultimately serving better the protection of white phenotypes. One of the practitioners has referred to the genetic laws of inheritance at one point in our talk:

> In the general population, blondness and blue eye-colour are much less frequent than dark with brown eyes, because genetically it is like this because it is expressed as recessive (Gynaecologist 2).

In refusing to assign a dark donor to a White recipient, the doctors enact the dominant/recessive genes logic for the case of skin colour, thus avoiding overruling in artifice the laws thought to be given in nature, that is, that white combined with dark will likely produce a person of darker skin than the mother. These answers exemplify the ways in which racial coherence (and more specifically in this case, Whiteness) are upheld on the basis of a scientific reasoning, insofar as the matching choices are underpinned by a simplified version of knowledge about the dominance/recessiveness of certain traits. It is in this sense that one could say that the doctor is performing her scientific role: from a biological point of view, the progeny cannot have traits (like Whiteness) that are not present in the parents, while certain traits are recessive combined with others, so it would lack logic to assign a dark donor to a White recipient, insofar as

a dark offspring would be contradicting nature's given laws. Hence, while scientific arguing on one side, and the achievement of racial coherence on the other, may be said to be two different kinds of practices (one pertaining to the rational discourse of 'science', the other one to 'culture'), the examples above show that they come together at this particular case, that is, when the egg recipients are White. If the patients to be treated are of "white" skin, science is put in service of obtaining racial coherence (namely, the continuity of Whiteness), while this may be less the case when the patients are of darker skin:

> LA: Do you pay more attention in avoiding to assign a dark donor to a white recipient than in assigning a white donor with a dark patient?
> N: Yes (...). I try... if the donor is White I know that a dark patient will not have a problem with me giving her a White [donor] (Nurse 1)

Importantly, this enactment of nature as having certain intrinsic laws works to materialise race (and Whiteness) as a biological and inheritable aspect of the relation between mothers and offspring. This materialisation has the effect of enacting donor children as *biological offspring* of their mothers. As part of a scientific milieu concerned with the organic as a set of given elements and laws, race is reinforced as an inheritable cluster of traits, something that is genetically bestowed on children by their progenitors, and something that cannot be biologically acquired unless present in the mothers. This reinforcement not only enacts the idea that nature has its own intrinsic norms (only those traits present in the parents are inherited; certain traits are genetically dominant over others). It also helps to sustain the socially relevant fiction that children born from donor gametes are genetically linked to their mothers[14], while ultimately working to protect 'white' as the colour passed on to children from mothers who have a light skin.

On the other hand, the hypothetical assumption regarding the Whiteness of the partner signalled above is also telling: it speaks of the presupposition, in giving a guesswork-like example, that a White woman's partner will be White, insofar as it is only given this condition that assigning dark to white lacks any logic. This assumption hence evinces (White) partners' racial coherence as a norm, formulated in the manner of a hypothetical presumption regarding people's preferences in choosing a sexual partner. The assumption that the partner will be White points, however, in a different direction to that concerning the enactment of race as a biological fact: Why is, in effect, such colour coherence expected between partners? I argue that one way of making sense of this assumption about the Whiteness of the partner is acknowledging it as a part of a material understanding of race as cultural inscription, as a form of belonging that

[14] And, by extension, that children are also biologically linked to the relatives of the mother (grandparents, siblings).

is different to the mere possession of biological traits. In effect, there is no 'natural' pre-requisite to select a partner whose biological constitution, understood as an inherited set of qualities, is similar to oneself – yet there may be social aspects related to taking part in a shared culture that may influence such a selection, including the 'naturalisation', or passing as rooted in nature, of such criteria about whom to associate with. Here, the assertion that 'it is a matter of logic' to avoid assigning dark to White makes patent an enactment of race as a cultural element of identity. This performance of race, and of the necessity of racial coherence, is better expressed in the second quotation given above, which explains that the reasons for attempting to maintain parents/children colour continuity have to do with the 'thousand-year-old separation between Whites and Blacks', an assertion that points in the direction of a material understanding of race as culture.

Other testimonies from doctors further point to how the matching acquires sense in relation to widespread forms of phenotypic and ethnic appreciation based on ideas about race as culture, where such appreciations enact potent and frequently open forms of discrimination. As one practitioner said:

> G: Well, [phenotype matching] is the issue of donation (...) There are women *who have deeply entrenched the issue of descent and the colour of skin, and the colour of the hair and of the eyes, and maybe they come from Italians or from Jewish* or from whomever it is, and *they won't accept that their baby doesn't have the same characteristics as them* (Gynaecologist 2, my emphasis).

As the preceding quotations show, if race is enacted as a culturally (as well as a biologically) inheritable aspect of identity, it may well be that in Argentina the failure to pass on certain biological traits is seen as a failure to pass on identity and cultural belonging. This supports Charis Thompson's finding that "genes have social categories built into them" (2005, 181). Moreover, in a country traditionally pervaded by narratives of the prevalence of European Whiteness, the inheritance of biological features different from those on which belonging to a family and to Argentine Europeanness and/or Whiteness are thought to be grounded, may be regarded as a 'giving up' on the prominence that white phenotypes have.

In effect, the following quotations suggest the specific sense that such 'giving up' might entail. This points to how it may be precisely the presence of an unacknowledged part of the population, the Indigenous non-European component, that acts as a threat to what is regarded by sectors of the population as Argentine (and specifically *porteño*[15]) Whiteness. It may be in fact that the mestizo phenotypes that carry the stigma of rural migration, lack of education and development want to be avoided, lest

[15] Meaning people from the port, people from the capital city (Buenos Aires).

they are passed to the unborn child if present in the donor. As two practitioners said:

> There are patients that (...) explicitly ask for similar phenotypic features in the donor, *that she is not, let's say, if I am blond and blue-eyed that the donor is not a darky-haired*[16] *from the Altiplano*[17] (Embryologist 2, my emphasis).

> LA: so there is a lot about this social thing about the colours... but do you think that this preoccupation happens in both senses, those who are of white skin that [the donor] is not of dark skin, and the other way around as well?
>
> G: *I don't know if the other way around as well. At least couples who are more morochones do not transmit so much the anxiety of 'what are you choosing?'* (Gynaecologist 1, my emphasis).

These extracts show not only the work of a racial classificatory system where belonging both to a family and a wider social group, and countering the potential stigma of donor parenthood, seem to depend on the coherence between mothers' and offspring's physical appearance. They also point again to what I have signalled as a future line of enquiry: the relevance of the matching especially in the case of white phenotypes, and its strategic – albeit probably not intentional – naturalisation as a form of ensuring the transmission of Whiteness when this trait is present in the parents.

A final example further sustains the claim that race is enacted as a biological and cultural aspect of kinship in the medical making of family filiation, and how this enactment, which entails making kinship real through race, is based on the conflation of science and race. Trying to find out more about how assignations happen in the clinic, I asked about rare cases and if patients ever demanded specific things to the practitioners:

> LA: Has it ever happened to you that a couple or a woman comes and they ask for characteristics that she doesn't have?
>
> G: yes, it happens...
>
> LA: that she does not look like that and she asks for.... And what do you do in those cases?

[16] 'Morochita' in the original. The use of the diminutive form ('morochita' from 'morocha', dark-skinned) is probably intended as a derogatory form, used in an ironic tone by the practitioner, who is reproducing the recipient woman's voice.

[17] The Altiplano refers to the high plateaux of Bolivia and Peru, whose population composition is markedly of quechua and aymara origin, phenotypically visible in dark skin, eyes and hair, and less common in Buenos Aires. The Altiplano figures here by extension as a synonym of the Northern provinces of Argentina, whose population by geographical proximity is also in high proportion of quechua and aymara origin, and typically subdued in economic terms.

> G: well, *you try to dissuade her, or you tell her that she will have to wait*. But in general *we don't pay attention to that*, we don't pay attention to that...
>
> LA: but do you tell her that you will not be looking for something like this?
>
> G: we try to tell her and we try to make sure that her main doctor convinces her before she reaches the point of matching, *because she is coming to look for a baby, she is not coming to look for a prototype of anything* (...) I personally don't agree. *Because she is coming here to look for a baby. You can't ask for something that you are not* (...) *If I am dark-skinned, black, very black, with frizzy hair like Black people have, and I am seeking a baby that is of German descent*, what is the point...? To feature in a debit card ad? *No, it doesn't exist*[18] (Gynaecologist 2, my emphasis).

Here, the practitioner recounts the scolding answer that patients may get if they express desirability for a child with characteristics that they do not have. Once again, white racial coherence is sustained on scientific claims: genetically speaking, a person cannot inherit genes – like those that produce a 'German' phenotype – that her ancestors do not have. Yet this genetic impossibility ('You can't ask for something that you are not') condenses as well a moral reprimand and command: lest the baby becomes a prototype and, one may further argue, a disconnected being, racial coherence needs to be sustained. Science cannot do what nature would not: sustaining this imperative entails making racial (White) coherence visible, and doing this, making kinship real, making 'babies' rather than just scientific products.

As the above makes clear, the search for (white) colour coherence sometimes allows for the emergence of different valuations of body colours ('if I am blond and blue-eyed that the donor is not a darky-haired from the Altiplano'). The implication is that body elements that culturally code for race, like the colour of the skin, are the object of an ordering (but also dividing) activity through which some are cast off ('darky-haired') in order to preserve others ('blond and blue-eyed'). Such exclusions and preservations work in Argentina on the basis of a set of presuppositions: that race is a form of cultural belonging partially encoded in genes, and that therefore some neat separations need to be scientifically preserved ('you can't give two very blond persons the ova from a dark skinned donor'), ultimately contributing to the culturally significant preservation of white phenotypes.

[18] Affirming that 'something doesn't exist' is a native Argentine (mostly porteña) expression to convey that something is morally reproachable, or that it is, for some reason, unacceptable.

7. Conclusions

In this article I have explored the ways in which race is enacted in medical practices that aim at helping persons procreate with the use of donor gametes. In doing so, I have argued in favour of acknowledging some of the ways in which race enters, and helps to sustain, a regime of visibility whereby family links need to be *made visible* in order to count as such, in order to be real. This 'necessity' is not given in social or medical discourse, however. In effect, in Argentina the institutional and more widely political presentation of ARTs is constructed around the idea that the latter help to make pregnancy and parenthood possible for those who *wish it*. In this discourse, *procreative will* features as a key justification for the use of ARTs, the necessity for, and right to, its public funding, and for permissive legislation, among other demands. And procreative will is another form of talking about kinship: those who wish to procreate *are willing* to establish family relations; they *want* to be entangled. This world of voluntary acts, willingness and decision appears thus to be irretrievably linked to kinship: to wish to be connected (with one's children) is almost like already being so; a bond has already been established by the intention itself.

However, this world is rarely articulated in terms of race. Donor conception is institutionally and more widely culturally predicated as a matter of right and decision; yet it is also in other ways connected to stigma, secrecy and shame, which derive from being incapable of reproducing with one's own gametes; from the lack of biological continuity with the offspring; and with issues associated with exchanging gametes for money. Donor conception is frequently spoken also as a matter of psychological well-being: if one cannot procreate with one's own gametes, one first needs to 'accept this', then 'accept a cell from another woman'. Then, one may be ready to bond with the (donor) child.

It has been my argument here that the discourse of decisional 'bonding' from which race is almost erased speaks subtly of a certain insufficiency, that of social labels like 'mother', 'parents' or 'offspring' (themselves linguistic embodiments of 'kinship') to *actualise*, or be able to materialise, the kinship that they are meant to express. Because to call someone 'mother' or 'daughter' when there has been donor conception appears not to be enough if the kinship described by the word cannot be *actually seen*, if it is not apparent. This insufficiency is, of course, immanent, and almost never an explicit topic. Yet my analyses have shown that in the 'doing' of techno-scientific kinship through the matching of phenotypes, such insufficiency is at stake, actually instigating its own reparation. Race plays a key role, I have contended, in the mending of what are enacted as donor conception 'damages': the dangers of a lack of bonding, the presence of money, the potential appearance of physical dis-similarity. It does so, again, in immanent ways, rarely being said, yet actually *being*

done. This doing is part of, and enables, different forms of visibility, in ways that show the significance, in Argentina, of keeping to a family by way of keeping up the appearance of biological kinship. The first analytical section of the article argued that the socio-technical arrangement in which race is deployed helps to make body colours visible, allowing the seeing of colours in their empirical, bodily appearance. In fact, it is race that provides the *lens* through which otherwise abstract skin colour differences become real, a concrete experience. By providing the lens through which formal colour differences can actually be seen clearly and distinctly in people, race becomes inscribed in people's bodies, and thus produced as a biological matter. This production is made possible by the sociotechnical interaction between the form and the practitioner, which taking place in an inscription device, both produces race as a 'material substance', and brackets off such production. In the second section, I have pressed metaphors of visualisation in a different sense. Examining how medical practitioners argue through scientific idioms the need for racial coherence, and how simultaneously race provides not a random, but a very meaningful example of the workings of nature, I have suggested that it is the avoidance of racial in-coherence, and more specifically of the discontinuity of white, that helps to make kinship visible, and in this sense to make it real.

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Understanding the "National Innovation System" Conceptual Approach as a Social and Governmental Technology

Naubahar Sharif
Hong Kong University of Science and Technology

Abstract Drawing on pioneering work by Pinch and Foucault, this paper argues that the national innovation system (NIS) conceptual approach that emerged from innovation studies in the 1980s and 1990s constitutes a social technology intended to induce policymakers to adopt a sophisticated model of the role of innovation in a national economy when formulating policies for stimulating economic growth and development. In this respect the NIS approach has also served as an instrument of governmentality, making an emphasis on technological innovation attractive to the relevant actors in policymaking, industry, and related institutions. The paper draws on qualitative empirical research to show that, like any social technology, the NIS approach can be used for purposes other than those for which it was designed by revealing its use as a rhetorical device by Hong Kong policymakers for political purposes. The study reinvigorates the concept of a social technology for science and technology studies.

Keywords: National innovation system; technology; social technology; governmentality; Honk Hong.

Corresponding author: Naubahar Sharif, Division of Social Science, The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong SAR – Email: sosn@ust.hk.

1. Introduction

In this paper I draw on pioneering work by the sociologist of science Trevor Pinch and the philosopher and intellectual historian Michel Foucault to argue that a conceptual approach to the study of innovation and economic development, one that has made its way from scholarly research and discourse into policymaking circles, functions as a social technology that has become what Foucault calls a governmental technology. I also provide empirical evidence of its use as a social and governmental technology in Hong Kong.

It is, to be sure, somewhat counterintuitive to conceive of an abstract construct in the social sciences as a technology. When most people think of a technology they imagine some new device or machine that makes a specific task easier to accomplish. Both Pinch and Foucault identify systems containing abstract elements as "technologies," however, and I will attempt making a similar case that in regarding a scholarly conceptual approach as a social technology we are able to see the key characteristics of such a technology, which generally combines concrete with abstract elements to do what all technologies do: change how people behave in order to achieve some goal.

The scholarly conceptual approach in question, broadly understood, is that of a national innovation system (NIS). I will argue here that the manner in which this conceptual approach has been developed in the academic sphere and subsequently disseminated from there into educational, policymaking, and industrial institutions is characteristic of a social technology. In the course of my argument I will introduce the NIS conceptual approach, explain in what sense it has become a social technology, and reflect on what that implies, again by reference to Pinch's analyses and Foucault's thinking about what he termed "governmentality" in his work on the development of the modern state and its relationship with those whom it governs. When scholarly experts pass the NIS approach on to policymakers, it becomes a technology of government, applied either through government agencies or through non-governmental organizations that in some cases are funded by government. To illustrate a possible implication of my analysis I consider additional questions raised by Pinch pertaining to the testing and implementation of social technologies. These questions suggest that by treating the NIS conceptual approach as a social technology we can achieve a richer understanding of the process through which innovations are driven by and in turn drive developments in the wider context of public and private institutions with potentially far-reaching economic consequences.

When I turn to the use of the NIS approach as a social technology in Hong Kong, however, I show that, like any technology, its originally intended use may be superseded for another purpose. In the Hong Kong case, I offer evidence that government officials used the NIS approach for rhetorical purposes rather than as a model for generating economic development and growth (Sharif 2010). To be sure, this illustrates the broader purposes of a governmental technology, which often includes laying the groundwork for making government policies easier to implement by creating receptive constituents.

The NIS approach was introduced by researchers in the 1980s in the context of growing interest in economic development as international institutions studied the gap between the developing and the developed world. Among these institutions is the Organisation for Economic Co-operation and Development (OECD), which promotes financial stability and the global spread of market forces with the goal of enhancing the

economic status of developing nations. In broad terms, according to the OECD, an NIS comprises a "set of institutions that (jointly and individually) contribute to the development and diffusion of new technologies [… providing] a framework within which governments form and implement policies to influence the innovation process" (OECD 1999, 24). As we shall see, the institutions in question bring together actors in the public and private sectors by marshalling resources from universities, industry, research bodies, and government agencies in the course of which innovations are created and commercialized. The NIS approach provides a framework within which to comprehend the full scope of an innovation system against the backdrop of global economic trends while taking the play of historical and contemporary national specificities into account.

In developing the NIS approach, innovation scholars have replaced a linear, somewhat static model with a more dynamic model featuring interactive, multidirectional relations with feedback loops among the component parts or actors.[1] If there is reciprocity in these relations between actors, so there is, as Rose and Miller (2010 [1992]) argue, "reciprocity between the social sciences and government. As government depends upon these sciences for its language and calculations, so the social sciences thrive on the problems of government" (280). It is here that governmentality through "technologies of government" (281) comes into play. If the NIS conceptual approach is such a technology of government, then its function as such depends on a "complex assemblage of diverse forces" that enable "the decisions and actions of individuals, groups, organizations and populations […] to be understood and regulated in relation to authoritative criteria" (281). As defined by the OECD, the NIS conceptual approach provides the criteria by which a government can channel advantages and resources towards actors it hopes will engage in the sort of innovation-related behavior that academic innovation experts assure them will fuel economic growth.

The NIS approach is a two-dimensional construct that has migrated from academic into policymaking circles as innovation policy is utilized increasingly to drive economic development. In this movement into the hands of government actors, scholars propounding the NIS approach reflect Rose and Miller's (2010 [1992]) observation that "experts […] ally themselves with political authorities, focusing on their problems and problematizing new issues, translating economic concerns about […] innovation […] into the vocabulary of management" (286). Indeed, as I will argue, the NIS approach has become a social technology to the extent to which it functions as a means of promoting innovation by *altering the behavior of* government policymakers and the agencies they represent, who in turn utilize the approach as a governmental technology. Conceived in

[1] This makes the Hong Kong case all the more interesting because its version of an NIS was more linear than holistic when I conducted research on this question. See section 4 in this paper.

this way, the NIS approach can be understood as an application of Foucault's analysis of power relations, that is, as an instance of the rational application of techniques of government to serve (in this case) an economic purpose.

Foucault's work on what many call the analytics of power led him, by the late 1970s, to coin the term "governmentality", providing him with a concept that brings together his thinking about what he termed the "genealogy of the state" and the "genealogy of the subject". As Rose (1993) puts it, on Foucault's analysis governing entails "a certain *mentality* of rule. Govern*mentality* is a way of problematizing life and acting on it" (288, original emphasis). The need for governmentality, a rational approach to state governance, arose as a result of historical developments running roughly from the sixteenth into the twentieth century as previous modes of sovereignty gave way to the modern state. What Foucault calls the problematic of government involves the state's twin imperatives to control and care for its subjects, now reconstituted as a "population".

In his later thinking Foucault came to view power or dominance as but one modality of governance, arguing that similar relationships occur at all levels of human interaction, among institutions as well as individuals. As the modern state evolved, a new category of analysis, that of political economy, emerged with the state's interest in duplicating in a whole society the "economy" of the family, taking on the traditional role of the father or household head, whose job it was to see to the orderly management of his property and its inhabitants. In this way the state assumed a kind of pastoral power over its subjects, which is as much about health and welfare as about subjugation, even as it sought to consolidate its political power. This means that the state's power relations with its population involve much negotiating over the terms of those relations through interactions between individuals and government agencies or institutions, thus requiring considerable individual autonomy even as it also seeks to mold individuals into proper citizens. The trick is to create a population of individuals, or selves, who are properly governable.

Governmentality thus signifies the development of the state as a source of technologies the purpose of which is to secure these two overarching ends. Rather than controlling subjects like a sovereign monarch through directly coercive "juridical" power, the state now seeks to inculcate in the population patterns of self-governance through "pastoral" power, using state institutions to steer the population towards health and prosperity. Foucault argues that in adopting this new role the modern state must deploy governing technologies that operate at the level of the individual subject, what he calls "individualizing" technologies, as well as at the level of the whole population, what he calls "totalizing" technologies. In this regard he is, of course, concerned about the fate of the autonomy of the subject, but for our purposes the important point is that governmentality, whether in the hands of the state or in the hands of private institutions through which state power is diffused, is about causing

other people to behave in particular ways that keep things running smoothly. In this sense a government technology, as I will argue presently, is also a social technology, a means of altering human behavior on a social level to serve particular ends.

At the same time, it is important to understand that although Foucault's work on governmentality resulted from a sweeping historical analysis of the genealogy of forms of state governance, the concept applies to any relationship between people or institutions in which persuasive discourse and other techniques are deployed in an effort to shape behavior, whether one's own or another's. Just as the modern "neo-liberal" state uses governmentality to create a population susceptible to its technologies of power, so individuals, and other non-state actors, use governmentality to affect the behavior of others and themselves.[2]

Accordingly, as the NIS approach has moved from academic to industrial to government policymaking institutions, it has become an instrument for engineering a particular set of social relations connecting actors in each of those domains, namely those that constitute inputs to and outputs from the process of innovation, even while shaping the process itself.[3] In Foucauldian terms, the set of institutional and personal relationships, along with the material and abstract components that facilitate those relationships, constitutes a "*dispositif*", what Rose (1993) terms a "machine for government, each of which is itself an assemblage of diverse components, persons, forms of knowledge, technical procedures and modes of judgment and sanction" (p. 287). In thus framing the NIS construct, I am picking up a lost thread in the literature because the idea of a social technology has received limited attention in S&TS recently (after early work by, for example, Ashmore et al. 1989; Pinch et al. 1992; Mulcahy 1998).

Before I introduce the NIS conceptual approach properly, I will briefly mention the critique of the "social" levied by Latour (1993; 2005) and Callon (1986; 1987). In short, I do not take up this issue robustly in this paper, as I prefer to focus on how the NIS approach has been utilized irrespective of the appropriateness of the label "social" technology. I will be clear about what this means for my purposes, and I will note at least

[2] A concise but systematic introduction to Foucault's concept of governmentality is available in Burchell et al. (1991), which includes not only a lengthy introduction to the concept by Graham Burchell (Burchell et al. 1991, 1-52), but also excerpts from Foucault's lectures in which he introduced the concept, under the title 'Governmentality' (87-104).

[3] An example of the way in which the NIS has become an instrument for engineering a particular set of social relations can be found in Finland, where connecting actors in the innovation system has recently become an explicit policy goal (see Schienstock and Hämäläinen 2001, 12 and 178-199). Within such a framework, "the widening and deepening of network-cooperation has become one of the central issues for the developing of innovation system" (The Science and Technology Policy Council of Finland 1996, 42).

one juncture at which there is some commonality between my account of a social technology and Latour's and Callon's approach, particularly regarding the role of material objects in an "actor–network". On my account social technologies – as is true of the NIS conceptual approach – very likely include material objects as components that act on other components. This idea is part of Latour's and Callon's critique of the social, but it would divert me far from my purposes to undertake a broad philosophical defense of the social in this paper.

2. The National Innovation Systems (NIS) Conceptual Approach

2.1. Two Interdependent Dimensions

To understand my focus on the *national* innovation system construct, it is worth noting that, within academic and policy spheres, the innovation system conceptual approach exhibits considerable variation with respect to an innovation system's scope or field of application – there likely are regional innovation systems as well as innovation systems tied to particular technologies or industrial sectors.[4] In regarding the innovation system conceptual approach as a social and governmental technology, I am committed to following its use among policymakers, and by focusing on the effects of policy at the national level we can readily trace the influence of the conceptual approach as an instrument of social engineering. I therefore focus on the *national* innovation systems conceptual approach; when I use the briefer "innovation system" it should be understood as a reference to an NIS.

In spite of its recent advent and relatively low profile in the S&TS literature (for exceptions, see Miettinen 2002; Sharif 2006; Albert and Laberge 2007), the NIS construct has been used extensively in academic and government circles. In the academic domain, innovation systems are the focus of study in many scholarly research programs, especially across northern Europe and Scandinavia.[5] In the government domain, the inno-

[4] Innovation systems have been identified based on spatial, technological, and sectoral criteria. In addition to 'national' innovation systems, for example, we can identify 'regional' innovation systems (Silicon Valley is a clear example), 'sectoral' innovation systems, (such as is likely the case with energy-related industries); and 'technological' innovation systems (some would identify innovation in semiconductor manufacturing as such a system). I shall not in this paper consider the comparative merits of the delimiting criteria used in classifying innovation systems; what matters here is the structure and functioning of an innovation system, which in all its permutations exhibits similar properties.

[5] England houses the 'Science Policy Research Unit' (SPRU) in Brighton, and in Manchester the 'Institute of Innovation Research' and the 'Center for Research

vation systems approach began to exert considerable influence during the 1990s. As a result, public policy in many countries and public institutions shifted in orientation from supporting science and technology *per se* to supporting the broader innovation process. That is, instead of supporting science and technology for their own sakes, by channelling that support through the innovation pipeline governments target economic development or growth as the intended outcome of innovation policy. Led by such international bodies as the OECD (OECD 1996, 1997, 1999) and the European Commission (European Commission 1994, 1995, 1996, 2002), a number of government agencies have followed suit. As I will show, the prestige of the OECD has drawn interest to its version of the NIS approach beyond its European sphere of influence, specifically, in Hong Kong. Yet the OECD's conception of an NIS arguably loses its purchase there, as Hong Kong government officials use it less to shape than to sell its development policies.

The NIS conceptual approach in practice exhibits two interdependent dimensions – one descriptive and the other prescriptive – and to understand it holistically we must understand how it has come to serve both descriptive and prescriptive purposes. The descriptive dimension and the prescriptive dimension co-determine one another, because how we describe and analyze an NIS is in part a function of the outcomes we pursue with innovation policy, while policy options are delimited by what we learn in analysis and description. In particular, targeting positive economic growth and development drives the description of an NIS insofar as it channels analysis to identify social and productive relations that conduce to such growth and development. On the other hand, effective innovation policymaking depends on accurate identification and analysis of existing conditions. It is difficult to move an economy from point A to point B if you do not know where point A is. In Table 1 below I summarize the key characteristics of the two dimensions of the NIS conceptual approach.

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on Innovation and Competitiveness' (CRIC). Germany hosts the 'Fraunhofer Institute for Systems and Innovation Research,' while the Netherlands has the 'Maastricht Economic Research Institute on Innovation and Technology' and the 'Eindhoven Center for Innovation Studies' (ECIS). Scandinavia boasts the 'Centre for Technology, Innovation and Culture' (TIK) in Norway, and the 'Danish Research Unit for Industrial Dynamics' (DRUID) in Denmark, largely populated by researchers from Aalborg University. Denmark also features the 'Copenhagen Business School', which studies innovation systems. Sweden features the 'Centre for Innovation, Research, and Competence in the Learning Economy' (CIRCLE) at Lund University and the 'R&D and Innovation with Dynamics of Economics' (RIDE) research center at the Chalmers University of Technology in Gothenburg. At Linkoping, the Center for Studies of Humans, Technology, and Organization also conducts innovation systems research. Across the Atlantic, Canada has the Centre for Policy Research on Science and Technology at Simon Fraser University (at Harbour Centre) in Vancouver, which employs the NIS conceptual approach as its underlying framework.

	Descriptive Dimension	*Prescriptive Dimension*
What is done?	Identification and description of innovation system inputs, outputs, and relationships among institutional components	Analysis of the system's components to map their interrelations and trace innovation flows
Why is it done?	Accurate representation of inputs, outputs, and institutional components is necessary to ensure effective analysis	Effective analysis of linkages – including their nature and intensity – among factors that affect inputs so as to maximize outputs
What are the results?	Well informed innovation policymaking	Policy recommendations that lead to positive economic growth

Table 1 – Two Interactive Dimensions of the NIS Conceptual Approach.

2.2. Distinguishing the Descriptive from the Prescriptive Dimension of the NIS Approach

How scholars describe the constituent elements of an innovation system partly determines how such a system is analyzed and subsequently treated by policymakers. Here, then, we review the defining characteristics of an NIS-based descriptive analysis in order to understand what it means to adopt the NIS approach within the academic domain – comprising a set of interrelated academic disciplines – as well as within the policymaking domain in which government agencies operate.

As noted by Edquist and Johnson (1997) and Edquist (2005), defining the science and technology components of an economy in NIS terms serves two primary functions. Within the academic domain, the NIS approach creates boundaries by reference to which NIS practitioners and policymakers can differentiate how they use the approach within their respective domains from the ways in which others who study technological change conceive of innovation. Second, the NIS approach establishes a set of criteria on which to base assessments of the effects of innovation on competitiveness and economic growth. In the policymaking domain, applying the NIS approach to a national system of innovation provides an alternative to the outmoded linear model of innovation that lingers in pol-

icymaking circles, capturing the multidirectionality of institutional relations whereby initial inputs beget intermediate outputs as well as backflows of information that inform ongoing innovative work.

From a theoretical perspective the boundary issues raised by the NIS approach shed light not only on its role in the transition through which research breeds innovation that is eventually commercialized, but also on the social constructivist approach to technology. In this latter connection, Gieryn (1983; 1995), in addition to considering how boundaries in science are used to demarcate science from non-science, emphasizes the 'work' conducted in creating boundaries. That is, boundaries are practical achievements that need continual maintenance, and this is particularly true of the nexus that links research to the commercialization of innovations, since the NIS conceptual approach carries over from the academic domain to the policymaking domain, providing a lingua franca that serves as a medium of communication through which knowledge flows. The descriptive characteristics of the innovation systems conceptual approach are conceived and defended by innovation systems practitioners to protect their particular ways of thinking. We see this not only in the academic sphere but also in the policymaking sphere, where NIS-style thinking has influenced government technology policies. As Gieryn suggests, the communities of scholars and policymakers who use the NIS conceptual approach set boundaries in order to access resources, protect autonomy, and maintain control over their domain of intellectual thought.

In addition to serving as a boundary object, the NIS construct also provides "a way of seeing" or a way of conceptualizing an economy that facilitates both research about and intervention in innovative activity. We cannot understand the NIS construct if we forget that, as it has made its way out of the academy into the market, it takes on a prescriptive or normative dimension in supporting recommendations to policymakers by making an in-depth understanding of any given innovation system accessible to non-scholarly actors, who are able to use it in comparing their national innovation systems with those of other countries in what has become, since the Cold War ended, "a world of international technology competition" (Elam 1999, 18). In this respect the NIS conceptual approach in effect induces governments to integrate technology and innovation policy into their broader economic policies. In so doing, governments avail themselves of a new tool, a governmental technology, for managing knowledge on an economy-wide basis. That it has also been used for rhetorical purposes might alter its influence on policy design, but it also illustrates another aspect it has in common with all technologies, namely being open to interpretation and a multiplicity of uses (see Mietinnen 2002, Sharif 2010).

3. The National Innovations Systems (NIS) Conceptual Approach as a Social Technology

Over its relatively short history, the NIS conceptual approach has become well established in innovation studies and in policymaking circles as a way of analyzing an economy to determine how innovations can be promoted for the purposes of economic growth, particularly in the OECD and European Commission, where growth and development are compared on a country-by-country basis. To show that the NIS conceptual approach has been deployed as a social technology, I first recall conventional characterizations of what makes something a technology, and then concentrate on features that pertain specifically to social technologies. In particular, I adopt the view that social technologies are designed explicitly and primarily to alter human behavior, which, in the case of the NIS conceptual approach, means first the behavior of government policymakers and the agencies they represent, and ultimately the behavior of actors at all levels of an innovation system, from technology researchers to designers to entrepreneurs – in short, everyone who plays a role in bringing innovative products to the marketplace. In Foucauldian terms, the NIS approach in effect reconstitutes all these academic, industrial, financial and government actors as innovation actors, and in so doing it harnesses both "individualizing" and "totalizing" technologies to boost economic growth.

Before exploring these and other implications of my characterization of the NIS conceptual approach as a social technology, however, we begin with a broad characterization of a technology *per se*. The difficulty of defining the term "technology" has been noted often by S&TS scholars (see, for example, Bijker et al. 1987; Kline 1995; Oldenziel 1999; Mackenzie and Wajcman 1999). To flesh out the idea that a technology is a practical application of a scheme for achieving a productive goal, I follow Wajcman (1991, 14-15) and Mackenzie and Wajcman (1999) in characterizing a technology in terms of three principal elements. First, a technology involves artifacts and systems that constitute what is primarily a material element, as it were the concrete objects and physical processes used in producing and applying the technology. Second, a technology includes an informational element, a combination of knowledge and skills that support specific techniques employed in producing and implementing it. The informational element of a technology provides the abstract structure that characterizes the productive relations through which the material components are manufactured. The third element of a technology is the set of social practices and relations that provide the framework within which the technology serves the purposes for which it was devised. In characterizing the NIS conceptual approach as a technology, I am committed to an analysis according to which it features all three of these elements – the material, the informational, and the social.

Note that such a combination of elements exhibits the heterogeneity that Latour and Callon attempt to capture with the concept of an actor–network, which typically includes nonhuman animate and inanimate objects as actors. Actor–network theory (ANT) thus posits that "an actor could be either a human or non-human entity and it could have both material and "social" components" constituted "by a shifting network of connections with, and differences from, other entities. [...] Instead of speaking of actors and their networks as if they were distinct objects, this approach suggested that it would be more appropriate to speak of "actor–networks'" (Berry and Slater 2010, 177). As I have noted, I am not addressing the applicability of ANT to the NIS conceptual approach here because I do not wish to address the question as to whether the nonhuman or inanimate elements of a technology, social or otherwise, constitute actors, or to take up an explicit defense of the social. As to whether a given technology has social effects, the effects that I describe later in the paper occur whether or not they are properly labeled "social".

In distinguishing the NIS conceptual approach considered as a social technology from material or machine technologies I nevertheless acknowledge its material elements, including the mundane physical items used by researchers and policymakers, such as computers, printers, communication devices and other forms of office infrastructure – paper, ink, etc. – as well as other physical manifestations – printed academic papers, policy documents, and so on. This paper is not the site for an extended discussion of differences between the role of material objects in what I am defining as a social technology and their role in a Latourian actor–network, but I will note that I am perfectly comfortable with the idea that each of these components plays a particular role only within the overall context of the way in which a social technology is applied to achieve its designed purpose. A particular configuration of ink on a page, for example, becomes part of a social technology because the context in which it is used in part determines what it means to other actors in the system through which the technology is applied.

In addition to the research-based content of the NIS conceptual approach – scholarly papers and the theories they expound, diagrams and other figures, for example (noteworthy for the role they have played in Hong Kong, which I discuss below) – we should also include in the informational element the software that computers and other devices run as well as the channels of communication through which content is passed from one actor to another. There is in this respect a rhetorical element through which NIS practitioners employ its descriptive and prescriptive dimensions in attempting to realize the objective of harnessing innovation to drive an economy's economic growth and development. That is, the rhetoric of the NIS concept when used as a social technology – the ways in which the particular configuration of components I have catalogued here are harnessed to act on human behaviour – determines how it is interpreted as a model of innovative activity at the national scale (or at

whatever scale it is calibrated at). The material and information elements act as technological components to the extent that they serve a technological purpose.

The *social* element of the NIS approach, then, resides in a set of institutional and personal relationships – some more formal than others – through which academics, business interests, and policymakers work together in conceiving, sharing, and implementing it in practice. What matters for my purposes is that it is through these institutional and personal relationships, facilitated by its various material and abstract or rhetorical components, that the NIS conceptual approach finds practical expression.

While the last two elements of a technology – informational content and social relations – may seem too human-centered or "low-tech" to fit our idea of a technology, they cannot be ignored because they change the organization of work as well as the organization of society and social relationships. The three principal elements of a technology may produce unintended consequences that undermine or alter the application of that technology, but they converge on an explicit purpose or pre-determined goal, and it is in terms of that goal that we should understand such a technology. I contend that the NIS conceptual approach is a form of knowledge, applied through the abovementioned combination of elements, that is used to conceptualize and analyze the ecology of an economy's institutions that affect innovations and on that basis it is also used to construct policy recommendations intended to alter the behavior of those constituent institutions and the actors who work within them. It is, therefore, a form of technology. It remains, then, to explain more fully why this particular technology is best understood as a *social* technology in the sense in which I am using that term.

To demonstrate that the NIS conceptual approach is a social technology, I refer to Pinch's research, in which he identifies several examples of social technologies that, in his words, include "artifacts, processes, or procedures (or combinations of these) which are built around or have embedded within them a systematic attempt to change human behavior" (Pinch 1987a, 2). To be sure, *any* technology once deployed influences human behavior in the trivial sense that, for example, we now use wireless communication devices instead of wired devices on a daily basis. Such a technological shift might well alter behavior on a social scale, of course, but there is no particular pattern of behavior beyond that of a new consumption behavior underlying the development of wireless communication devices. To say that the NIS conceptual approach is a *social* technology is therefore to say that its purpose is precisely to bring about new behaviors on the part of a class of actors taken as a population or significant segment of a population. In Foucauldian terms, as I have noted, when innovation actors operate within the framework of the NIS conceptual approach they have been reconstituted as members of a particular population or social class, as a totality that can be directed towards a common goal. To illustrate this, then, I shall briefly discuss two of Pinch's exam-

ples, showing how they meet the above-mentioned criteria in virtue of which they are indeed technologies, and then consider his characterization of a social technology as one that is intended to affect behavior on a social scale.

Insofar as our characterization of a social technology builds on the aforementioned characterization of a technology *per se*, it also faces the difficulty of clearly distinguishing the various elements of a technology from one another. Distinguishing artifacts, processes, and procedures from one another can seem arbitrary. To illustrate this, we first briefly revisit Pinch's account of an attempt to change the behavior of prisoners in the British penal system in the eighteenth and nineteenth centuries (from around 1770 until around 1840). The so-called "Separate System" of prison reform that was implemented during the Victorian era is, in Pinch's view, "a classic attempt to change the behavior of prisoners within the framework of a technological system" (Pinch 1987a, 2-3).

The idea of the Separate System was to keep prisoners in complete isolation from one another at all times of the day and night while subjecting them to a regular dose of Bible-bashing. The goal was to replace a prisoner's criminal personality with an open, "impressible" temperament that would render him susceptible to what we might now call behavior modification in the course of which the prisoner would be transformed into a person whose disposition would now be conducive to learning and practicing appropriate self-regulation and interpersonal behavior.

In this example, the social technology works within the framework of a largely material technological system (the prison). The component parts of this social technology included therefore many material artifacts: the prison itself, elaborate equipment that enabled wardens to usher prisoners in and out of group assemblies without seeing one another, and several machines that performed no useful work but nevertheless occupied prisoners' time in physical labor. To these material objects Pinch adds the personnel responsible for applying the Separate System, adding that "the Separate System *along with* the "technicians" [wardens, inspectors and the prison chaplains] who operated it comprised a potent social technology" (my italics; Pinch 1987a, 5). Finally, we must also include as essential components of this technology the set of abstract processes that specified the use of the physical components as well as the supervisory roles played by prison personnel as they regulated the behavior of the prisoners.

This description of the Separate System does seem to match our characterization of a technology, comprising the material, informational, and social elements. What makes it a *social* technology is its purpose, which as we have noted was to alter the behavior of the prisoners, to turn each prisoner, in Pinch's words, from "'criminal man' into an ordinary citizen" (Pinch 1987a, 19). It is this objective that made the Separate System, according to Pinch, a "classic example" of a social technology.

Foucault, of course, famously analyzed the emergence of the modern prison system (Foucault 1978 [1975]), but as he developed the concept of

governmentality his analysis of power relations underwent considerable refinement. In his later thinking domination becomes but one type of power relation among others, not all of which are intrinsically bad for either party (governing other people's behavior sometimes requires empowering them), and his new lines of thought superseded key elements of his earlier analysis. In later Foucauldian terms, the Separate System clearly wields both individualizing and totalizing technologies. The elaborate lengths to which the system goes to prevent prisoners from interacting with one another isolates them as subjects of the pastoral function of the emerging modern state, rendering them more susceptible to the individual moral uplift that the system was meant to facilitate. At the same time, however, the system also works at transforming the entire prison population, treating every case similarly, and glossing distinguishing features of their individual cases or personal histories in an effort to create a new class of citizens.

We have seen that, in the description of an NIS that follows from the NIS conceptual approach, we find counterparts to the components of a technology *per se*, but what makes the NIS conceptual approach a *social* technology is ultimately its purpose, which is to change the ways in which economic and innovation-related policymakers act in setting and revising economic policy and in turn to encourage innovation-oriented behavior on the part of actors throughout a national innovation system. In Foucauldian terms these policymakers and associated actors and stakeholders constitute a population, albeit a small one, that becomes the target of the NIS conceptual approach. In particular, the NIS approach operates by shifting the focus of policymakers from conventional policy frameworks (which often approach innovation policy with a largely repudiated linear model of innovation) to one that privileges innovation as a key driver of growth and development. It is this emphasis on shifting the framework within which policymakers and other associated actors operate as a population that has convinced me that the NIS conceptual approach is a social technology.

We can bring out some interesting consequences of this position by considering now another example of a social technology that Pinch has studied. Pinch et al. (1992) discuss an example that is perhaps more like the NIS case than the Separate System during the course of their analysis of the introduction of "clinical budgeting systems" into the British National Health Service (NHS) in the 1980s. Here they focus on an analytical technique that was intended to be applied to a large system that is, in terms of the scale involved, more on a par with a national innovation system, namely the NHS.

The clinical budgeting system was conceived as a way of bringing medical practice in the NHS into something akin to a market framework. In this sense it might represent what Berry and Slater (2010) have noted as "the role of economics in the constitution of markets" (175-176). In the face of a budget crisis the idea was to establish a new system for the

allocation of medical resources that would replace the old model, under which the ability of patients to pay for services played no role in determining that allocation. In analyzing this attempt, Pinch, Ashmore, and Mulkay committed themselves to treating "clinical budgeting as a "social technology" […] clinical budgeting incorporates some material technological artifacts – in this case the micro-computers and associated hardware and software. Again, however, such artifacts only take on meaning within the overall system. And again within this system is embedded a particular view of social behavior – the aim of clinical budgeting being to change the behavior of clinicians and to a lesser extent managers" (Pinch, 1987a, 17).

Here again this example of a social technology intersects an important point in Foucault's thinking, as he argued in an early work (Foucault 1973 [1963]) that clinical medicine had reconstituted the subject of medical practice with the elevation of the medical case as the primary focus of treatment. To be sure, Foucault's conception of power evolved considerably after this early work as a result of the self-criticism to which he subjected himself in the mid-1970s. As I have already noted, his expanded analysis of power and governing relations acknowledges non-juridical relations that involve more than simple domination. In its pastoral modality, Foucault argues, the modern state has assumed responsibilities for the welfare of its subjects that were akin to those assumed by pastoral Christianity for its parishioners. Here in the example of the British clinical budgeting system we have a social and governmental technology that clearly adopts the case as the determinant of medical treatment, a trend that is lamented by Tierney (2004), who argues that a recent movement to restore "the voice of the patient" to medical practice involves both the juridical power of the physician to judge the patient's responsibility for her own health and the pastoral power that individualizes a patient's specific history and health status.

In the clinical budgeting system example, the efforts on the part of the British NHS to identify cost-effective treatments of medical cases reoriented the pastoral responsibility of the state while reconstituting the individual patient as but one component of a system that would make costs easier to manage. In a study of nursing practice in the Australian health system that references Foucault, we find a similar reconstitution, as the hospital bed becomes less a place of caring than a commodity to be allocated:

> Though current nursing textbooks affirm the bed as a materialised location for nursing practice, its temporo-spatial representation now forms part of patient-management practices […]. Beds are a discursively contested location for nurses. Like patient medical records and the whiteboards used to map patient bed allocations, hospital beds are increasingly understood to have become rule bound as spaces for the administration or disciplining of time. (Heartfield 2005, 23)

This shift of focus to the case has in turn redefined the terms by which a successful disposition of a case is measured. Now length of stay, as indicated by bed turnover and re-allocation via whiteboards, becomes the key performance measure:

> As an intellectual technology, the whiteboard transforms the bed into a resource-space in which nurses enact managerialist administrative responsibilities to ensure smooth, stable, predictable and preferably brief patient hospital stays (Heartfield 2005, 25).

This process through which the bed is commoditized in an economy of resource allocation, which as we can see involves a range of mundane technologies such as medical records and whiteboards, parallels the intended effects of a reform such as clinical budgeting on the British NHS and exemplifies the results of the governmentalization of medicine.

The clinical budgeting system deployed by the British NHS can be seen as part of a general trend towards the replacement of individual patient care in which practitioners treat individual subjects as it were at ground level with a system in which administrators determine regimes of care based on population-level data on risk factors, and the administrators whom the reforms were meant to turn into budget-minded efficiency experts would through their efforts reconstitute the individual patient as an incidental statistical adjunct to the case. Here the social technology was meant to operate by turning medical professionals into experts on risk and cost-benefit analysis.

Applying this model of a social technology to the NIS conceptual approach, it is not difficult to identify in both the clinical budgeting system and the NIS conceptual approach the elements of a technology, with the former falling into the category of a social technology in virtue of its purpose, which was to alter the behavior of a subpopulation of actors within the British NHS. To see this, however, it is first necessary to distinguish two interrelated facets of the NIS conceptual approach. On the one hand, a national innovation system considered as an entity in *itself* is a system of objects and institutional/personal relations that operates within the geographic boundaries of a particular nation. A nation's innovation system thus comprises material and human elements such as firms, universities, research organizations, public and private laboratories, government agencies and facilities, and so on. On the other hand, the NIS *conceptual approach* aids in the understanding of innovation, technological change, competitiveness, and growth in the framework of theoretical or economic *analysis*. As an analytical tool, the NIS conceptual approach – as we have noted – is utilized not merely descriptively as a kind of inventory of material and human resources, but also *prescriptively*, with the express purpose of producing change in the way scholars and policymakers understand an economy's functioning, how innovations can be promoted (or inhibited), and how contributions to economic growth can be made

through the pursuit of innovative activity. In other words, as a policy tool it engenders changes in behavior in a small but influential population. Thus its role vis-à-vis a national innovation system is similar to the role of clinical budgeting vis-à-vis the British NHS.

This prescriptive dimension seems clearly to exemplify Foucault's central assertion that knowledge when harnessed in a social technology always involves power relations or governmentality. The informational elements of a social technology serve to empower experts (prison wardens, hospital administrators, influential academics specializing in innovation studies) to apply the technology to target populations (prisoners, medical care providers, economic policymakers) with the intention of building new efficiencies or orderliness into the institutions in which they operate.

Perhaps it would strengthen the intuitive appeal of the concept of a social technology and its application to the NIS conceptual approach to remember that, as I have described it, the components of both an actual national innovation system *and* of the process of analyzing such a system under the NIS conceptual approach include material elements. Whereas the material elements of the former include a set of institutions and organizations (for example, firms, research labs, government facilities, university facilities, and so on operating within a framework of laws, regulations, practices, and channels of communication), the latter – the NIS approach when deployed as a policy tool – also includes material elements such as papers, policy documents, and the computers used in the process of formulating, issuing, and implementing policy recommendations as well as the people associated with policymaking. Thus, while a national innovation system comprises among other things the material elements of a comprehensive multisectoral system, ultimately the purpose of the NIS conceptual approach (with its own material components) is to provide an analytical framework within which to understand those elements – material, information-related, and social – so as to change the behavior of targeted actors, institutions, and organizations primarily in a way that alters the nature and strength of their linkages through policy intervention.

Once we conceive of the NIS conceptual approach as a social technology, we can apply other S&TS theories, models, and tools to it in new ways as we analyze its advantages and disadvantages. For example, one such promising S&TS approach applicable to the study of an NIS is called the Social Construction of Technology (SCOT) model, with which it is possible to deconstruct the NIS social technology and examine the extent to which it has stabilized (Pinch and Bijker 1984, Bijker, Hughes, and Pinch 1987). It should be possible, using the concept of a social technology, to expand the domain of NIS analysis within S&TS yet further, perhaps in reference to other widely applied terms such as the "Triple Helix", the "Knowledge-based economy", and so forth. Surely there are, as well, other social technologies that would interest scholars in social studies of science and S&TS, and part of my purpose here is to remind scholars of this possibility.

I close my argument that the NIS conceptual approach constitutes a social technology with an observation apropos of Pinch's original work on technologies. The research agenda pursued by scholars interested in technology studies has included analysis of the conditions under which technologies are tested. Pinch (1987b) examined, for example, the investigation of the failure of O-rings in NASA's space shuttle *Columbia* in 1986, concluding that interpretations of tests of the O-rings on the part of engineers and NASA management were at odds. Some of the engineers, based on their interpretation of O-ring test results, had wanted to alter the criteria for launch pertaining to air temperature by applying limits to individual parts of the space shuttle rather than to the ship as a whole. Management overruled, with tragic consequences, fearing long delays in the flight schedule as a result. As Pinch describes it:

> It seems that two different interpretations of the [Launch Commit Criteria] were available. This, of course, is a point familiar within the sociology of science – rules have to be interpreted and it is this which allows interpretive flexibility to enter […]. Whether or not the Space Shuttle was in a working condition such that it could be launched depended on which of these two interpretations won out (Pinch 1987b, 12).

Pinch argues that "negotiations over the "workability" of a piece of technology do occur and this is a fruitful location for what he calls in that work the new sociology of technology. It is also another illustration of governmentality, insofar as every aspect of a social technology may be negotiated and such negotiations inevitably involve power relations and the defense of boundaries. Until disaster struck, NASA accepted a degree of risk that accommodated its need for launch and mission efficiency and defined what constituted a successful testing outcome accordingly.

In reference to the clinical budgeting case that I have mentioned here, Pinch and his colleagues observed that, even though few if any of the desired outcomes of the trial were realized, higher-level policymakers essentially ignored these outcomes because they were under budgetary pressure and they believed that clinical budgeting made sense "in principle."

The point here is that the testing of a social technology, like scientific testing and the testing of a machine technology, involves both interpretation of results and persuasive discourse. By the time a social technology reaches the stage of being tested in practice, there is often a social imperative behind it (Miettinen 2002, Sharif 2010; I show in the next section that government officials in Hong Kong felt such a social imperative when they adapted the NIS conceptual approach to their purposes, but it had less to do with shaping economic policy than with legitimizing their role as policymakers). Moreover, the testing environment of a technology is highly public, which distinguishes it from the testing of scientific hypotheses within the scientific community. Even a machine technology (such as an O-ring) is tested in a much more public arena than a typical

hypothesis in the physical sciences, but the testing environment of a social technology is by definition in the public arena. Yet the difference between testing a machine and a social technology is one of degree only:

> This difference in the testing of machine and social technologies is only a matter of degree and not one of principle. Indeed the whole weight of my argument is that for analytical purposes the underlying rhetorical and persuasive processes in science, in machine and material technologies, and in social technologies, should all be treated in the same way. (Pinch 1987a, 13)

Thus the British authorities in the NHS largely dismissed the negative results of their trials of clinical budgeting. They argued, first, that the testing environment was irremediably compromised by its being, in effect, the real world of clinical medicine, in which it was virtually impossible to control for a host of variables that might affect the results. Second, it was argued that because it was so difficult to change the culture of medical care within the testing environment, only a deracinated version of clinical budgeting was tested. Most social technologies, designed to alter human behavior in the service of some policy imperative, will be similarly difficult to test.

In the case of the NIS conceptual approach, we have already seen that the original research program out of which the conceptual approach emerged to be made into a social technology has not determined the form in which the conceptual approach has been adopted by the policymaking community. In some cases policymakers have referenced the NIS conceptual approach without fully appreciating the multidirectional complexity of the model. In Hong Kong, for example (which I discuss at greater length below), the NIS conceptual approach has served primarily a rhetorical purpose independently of the intent of those who formulated and developed it in academic work (Sharif 2010). Since the NIS conceptual approach has come into the policy arena with the express purpose of changing the behavior of key actors so as to encourage innovations that drive economic growth and development, the ultimate test of an NIS that reflects the conceptual approach is whether or not the economy adopting it experiences new or accelerated growth and development as a result. Clearly the public nature of the "testing" environment will make it difficult to control for a host of factors as well as to maintain the original content of the NIS conceptual approach itself. In such an environment, every political faction is likely to interpret the economic outcomes of innovation-related investment differently. Such is the effect of governmentalizing innovation.

Considering the complexity of a national innovation system, there would seem to be many processes and social transactions to which scholars in both social studies of science and S&TS might apply their analytical tools in order to understand the full range of issues that affect the invention and implementation of this social technology.

4. The NIS Conceptual Approach at Work as a Social Technology

Analyzing the NIS conceptual approach as a social technology commits me to the claim that, in the hands of academic experts and government policymakers, the framing of the relationship between innovation and economic growth and development through the concept of an NIS has influenced both the policymakers who are in a position to apply it to their work and the actors in an NIS who carry out economic activities. In this section I discuss evidence of this influence that I have discovered in past research, but I also note that several countries have adopted some form of the NIS conceptual approach in their policymaking agencies, including Sweden, through its "Systems of Innovation Authority" (known as VINNOVA); Finland, through its National Technology Agency of Finland (2002); the Government of Canada (2002); the Government of New Zealand (2002); the UK Office of Science and Technology (2002); the Government of the People's Republic of China (International Development Research Center, 1997); and Hong Kong, through the Innovation and Technology Commission in the Hong Kong Special Administrative Region Government (2004). In what follows I discuss in greater detail the case with which I am most familiar, that of Hong Kong, where ultimately the NIS approach seems to have played a different role from that which characterizes its application by the other aforementioned governments.

The case I discuss involves the use of the NIS approach by Hong Kong policymakers primarily for rhetorical purposes, but as I have noted I am not the first to study the rhetoric involved in the NIS conceptual approach. For example, Miettinen (2002) focuses on the political rhetoric involved in applying the concept of an innovation system to national economic policy. Albert and Laberge (2007) conducted an ethnographic study of how international organizations (in particular, the OECD) and regional public administrations (in their case, that of the province of Quebec, Canada) apply legitimation and dissemination processes, elucidating the socio-cultural processes that have led government officials to adopt the innovation systems approach in policymaking.

As I have noted, the brief account of the use of the NIS approach by policymakers in Hong Kong I now offer summarizes a study I have published elsewhere (Sharif, 2010). In the context of the present study the outcome may well seem ironic, because my research demonstrated that Hong Kong policymakers indeed used the NIS conceptual approach as a social technology to support its policymaking posture, but not as it was intended or expected by the scholarly experts who developed it (see Sharif, 2006, for an account of the development of the NIS conceptual approach) or as it was utilized by the OECD as a guide for policymakers.

Following the Asian financial crisis of 1997, Hong Kong's government struggled to reorient its economic policy so as to reinvigorate economic

growth by entering the emerging global knowledge economy. Hong Kong sought to plot a new economic policy by emphasizing technology and innovation, producing a series of policy briefs, forming commissions, and funding development institutions all aimed at generating economic growth through innovation and new technology. This new policy direction played out against a history of weak research and development (R&D) and innovation activity in Hong Kong's industrial sectors, comprising mostly small-to-medium-size enterprises that were reluctant to commit resources to risky endeavors such as new product development. They profited mostly from low-cost manufacturing operations and borrowed innovations.

Evidence of the Hong Kong government's awareness of the NIS conceptual approach took explicit form in a 2004 report issued by the Innovation and Technology Commission, titled *New Strategy of Innovation and Technology Development* (HKSAR 2004). To the best of my knowledge the term "innovation system" was used for the first time in an official Hong Kong document in this report, or consultation paper, and it was accompanied by a diagram of Hong Kong's innovation system (fig. 1).

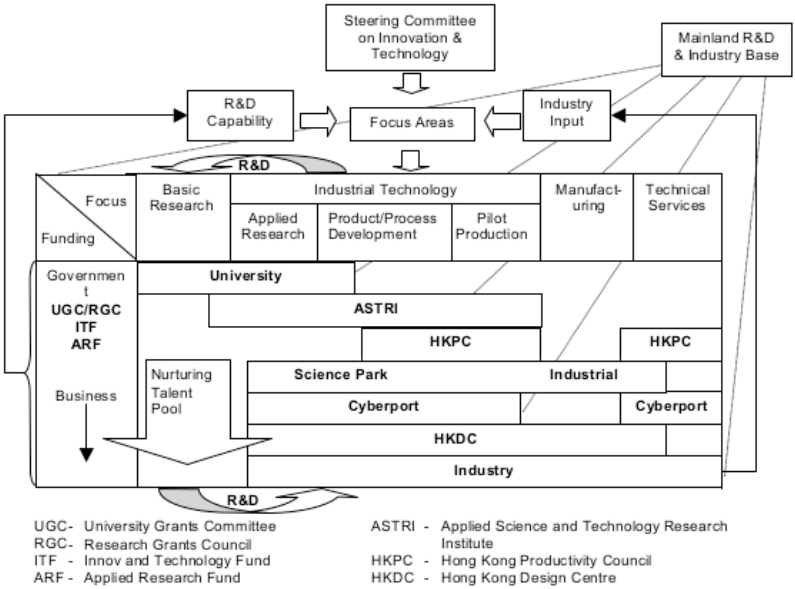

Figure 1 – Diagram of Hong Kong's innovation system from 2004 Innovation and Technology Commission consultation paper, under caption "Figure 3: Innovation under the New Strategy" (source: Sharif, 2006, from HKSAR, 2004, p. 18).

This diagram appeared in chapter three of the report, "New Strategy of Innovation and Technology Development", accompanied by the following brief paragraph, which appeared under the heading "Innovation System":

> Under the new strategic framework, it is hoped that various elements of the innovation and technology program could work closely together to generate greater impact along the R&D value chain from basic research to commercialization and production. [The] figure below illustrates the innovation system […] under the new strategy (HKSAR 2004, 17).

That this represents the entirety of any reference to Hong Kong's NIS in the paper informed my conclusion that in the government's hands the NIS conceptual approach was indeed a governmental and social technology.

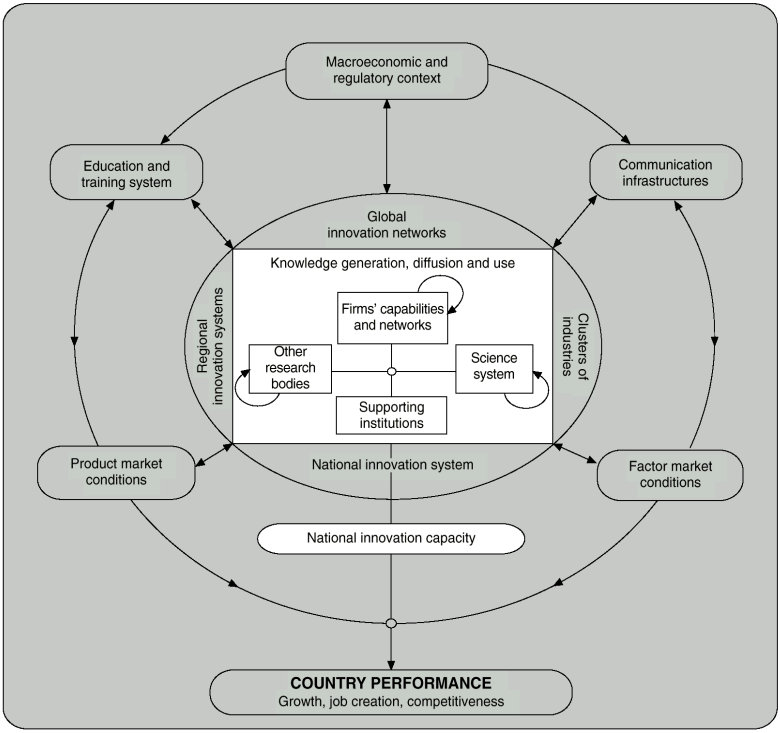

Figure 2 – OECD representation of a NIS (source: Sharif, 2006, from OECD, 1999, p. 23).

Yet another critical component of my research, which involved interviewing relevant figures in and out of the Hong Kong government who were involved in designing and carrying out its technology and economic development policies, led me to the conclusion that its purpose was primarily rhetorical. Based on these interviews I learned that Hong Kong policymakers were interested primarily in leveraging the prestige of the OECD to enhance the credibility of the government in its efforts to promote technology and innovation, not in following the model of the NIS approach that its academic progenitors or its advocates at the OECD would have recommended. Figure 2, which is a diagram of an NIS published by the OECD, makes this clear.

The OECD diagram depicts an NIS holistically as a nonlinear process involving actors from multiple sectors in complex interrelationships involving knowledge transfer and feedback. By contrast, Hong Kong's diagram of its own NIS represents a primarily linear process that proceeds from inputs at the top of the diagram to outputs at the bottom. I have shown (Sharif 2006) that the NIS conceptual approach was developed in the 1980s and 1990s precisely to supersede such an understanding of an innovation system. To be sure, the Hong Kong diagram depicts some degree of reflexivity in the system, but it depicts firms (represented by "Industry" at the bottom of the figure) almost as passive recipients of innovation outputs rather than as central actors in the heart of the process, as depicted by the OECD.

Thus although the designed purpose of the NIS conceptual approach would have been to help policymakers direct, or persuade, a wide range of actors to adopt practices that would strengthen links of the sort that are depicted in figure 2, instead its purpose was to persuade the public at large, which had lost confidence in the government, that it could be trusted to develop effective economic policy. To this end Hong Kong policymakers made a show of following OECD guidelines, something that I was told by one of my interviewees (this is a paraphrase of the remarks, not a direct quote, as none of my interviewees agreed to be identified or recorded):

> We do not just act blindly in arriving at our policy formulations. Our policies usually follow internationally accepted practices as found in the major publications, such as the OECD. When we see that the OECD and its member countries are adhering to certain guidelines, it helps – for international comparisons – that Hong Kong also follows the same international guidelines. Hong Kong is an international city! This helps when we want to compare ourselves to, say, Singapore or Taiwan or any of our other neighbours […]. The OECD has published reports on the innovation systems model showing it is an important model (Sharif 2010, 425).

Thus, while policymakers published their own version of Hong Kong's innovation system that misrepresents how those who developed the NIS approach understood it, they also in the abovementioned consul-

tation paper referenced the OECD to assure its readers that their plans for promoting economic growth through technology and innovation conformed to international norms.

This case illustrates the interpretive flexibility of the NIS conceptual approach as a social technology, but apart from the circumstances of its actual use by Hong Kong policymakers – who departed from its designed-for use – we see here also that the NIS approach features the signature elements of a governmental technology. As it migrated from academic studies to a non-governmental development organization to a government agency, it involved a heterogeneous "assemblage" (Rose 1993) of human, material, and abstract components – or actors – including the diagrams reproduced in figures 1 and 2, which illustrate the rhetorical component of the NIS approach.

5. Conclusions

In arguing that the NIS conceptual approach is a social technology, I have attempted to revive a largely forgotten category of analysis. This should benefit, I believe, both those who are interested in innovation as a driver of growth and development and scholars in the sociology of technology and S&TS. The former, an interdisciplinary and multisectoral community of scholars, engineers, corporate strategists, and policymakers in government and the public sector, may be able to pursue their common interests more effectively with a shared understanding of the NIS conceptual approach as a social technology. All actors interested in leveraging innovation to drive growth and development would profit from a better understanding of the ways in which their narrow interests might lead to interpretative conflict as they work together to allocate resources and implement strategies towards their ultimate goal. Similarly, scholars in sociology of technology and S&TS should achieve new levels of understanding by applying the concept of a social technology to a wide range of social phenomena and public policy initiatives.

By framing the governmentalization of the NIS approach partly in Foucauldian terms, I hope to have provided a familiar theoretical context within which to understand social technologies. These technologies fall into the broader class of governmental technologies, serving in this case to empower or reward individual and institutional behavior in a way that serves the state's economic purpose of fuelling growth. As actors in academia, industry, and government are reconstituted as actors in a national innovation system, as their roles are redefined and the terms over which they negotiate resource allocation and successful outputs evolve, scholars may benefit by situating these developments within a Foucauldian framework, in which they are seen as part of a wider genealogical fabric that weaves together individualizing and totalizing technologies in the state's ongoing historical development.

Whether or not one accepts the broad sweep of Foucault's analysis of the genealogy of the state, one need not view my analysis of the NIS conceptual approach as a social technology as suggesting an ominous extension of state power into the economic sphere. In its mature form Foucault's analytics of power, as we have noted, acknowledges beneficial outcomes of power relationships and the emergence of positive values in spite of the inherent dangers represented by totalizing technologies. By emphasizing the two-dimensional character of the NIS conceptual approach – consisting of both descriptive and prescriptive phases – I argue that it enables a new perspective on the process of innovation. This new perspective makes it possible to achieve a more complex understanding of a national innovation system with a multidirectional model that more clearly demarcates and delineates the various components and actors in an NIS, as knowledge flows and innovative developments travel back and forth along channels of communication and collaboration involving the higher education, industrial, and public sectors. By adding to this analysis the classification of the NIS conceptual approach as a social technology, I have made it possible to begin a new phase in innovation studies in which a better informed innovation community might more effectively utilize the resources available in order to modify the behavior of those actors and agencies who are best able to affect the outcomes of the innovation process.

More broadly, I have not only brought a specific area of study into the social studies of science arena, but I have, I hope, provided a basis upon which to add (or restore) the social technology construct to the conceptual toolkit of the sociologist of science and S&TS scholar. With this tool in hand, such scholars can open up new areas of study across a wide range of subject areas involving the public interest and sociological analysis. It may also provide a means by which to narrow the frequently wide gap between scholarly knowledge and policymaking reality as scholars, industrialists, and government agents pursue disparate interests for the sake of the common good.

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Latour in azione

Alessandro Zampieri
Independent researcher

Abstract: In this article, Latour's thought is analysed in a reflexive way from a philosophical perspective: the question is weather actor-network theory (mostly considered in his Latourian variation) has adequate traits to be a proper part of the ontology it designates; or if, on the contrary, it is a exception of itself. On the basis of the applicability of a reflexive analysis, Latour's philosophical production is divided in two temporal phases, each one undergoing a specific focus. A further level of reflexivity is finally adopted to discuss article's outcomes. The conclusion points out the need to imagine a "new" kind of "action", required to push further the attempt to think reflexively about ANT.

Keywords: actor-network theory; Bruno Latour; ontology; semiotics; reflexivity.

Corresponding author: Alessandro Zampieri, Via Mario Pieri 2, Milano, Italy – Email: alessandro.zampieri@gmail.com.

1. Introduzione

Da un punto di vista euristico, il principio dal quale si origina la presente analisi è ben espresso da David Bloor: il requisito della riflessività, come quello della simmetria, deve essere considerato "un requisito ovvio, perché altrimenti la sociologia sarebbe una confutazione permanente delle proprie teorie" (Bloor, 1976, trad. it. 13). La distanza che separa la teoria proposta dal sociologo di Edimburgo da quella di Bruno Latour è ampia almeno tanto quanto la differenza che passa tra le due differenti tipologie di costruttivismo da loro professate: sociale il primo e realista il secondo. Cionondimeno, con la dovuta traduzione, il requisito di riflessività rimane un valido terreno sul quale commisurare la consistenza anche per l'actor-network theory (ANT). Stando a Bloor, secondo il quale "tutto" è socialmente costruito, la teoria stessa con cui si afferma che tutto è socialmente costruito deve essere socialmente costruita; per Latour il discorso è analogo: data un'ontologia definita da e definente una teoria,

l'esistenza di attori che rappresentino un'eccezione ontologica potrebbe rappresentare un controesempio più o meno significativo; ma, se l'oggetto di studio fosse la teoria stessa nelle vesti di attore appartenente al proprio panorama ontologico, l'eventuale scarto tra le due avrebbe la possibilità d'indicare in modo circoscritto gli eventuali limiti dell'ANT. È il faccia-a-faccia dell'ANT con se stessa a caratterizzare riflessivamente la ricerca condotta in queste pagine[1]. In altri termini, l'ANT verrà considerata alla stregua di un esistente con le proprie specificazioni. Essendo l'analisi circoscritta alle suddette "proprie specificazioni", il presente studio ha carattere riflessivo.

La struttura intrinseca dell'analisi che si propone introduce un inevitabile secondo livello di riflessività, influente tanto sul corso della ricerca quanto sulle sorti di quest'ultima una volta al cospetto dei risultati: l'armamentario concettuale di cui ci si serve, in effetti, non è che l'ANT stessa! È questo terzo livello che conferisce la caratterizzazione di interno al presente studio, poiché le conclusioni a cui giungerà lo coinvolgeranno direttamente: servendomi dell'ANT per studiare l'ANT come attore concreto dell'ontologia che postula a livello teorico, gli eventuali limiti che l'ANT potrebbe mostrare ricadrebbero direttamente sulla ricerca stessa. Benché tale ulteriore livello eserciti un inevitabilmente peso sul corso dell'analisi, limiterò i riferimenti espliciti allo stretto indispensabile, riservandomi di prenderlo in considerazione più macroscopicamente nel paragrafo conclusivo.

2. Relazioni tra i costituenti dell'ANT

L'ANT è il risultato della stringente relazione intessuta tra la sua metafisica, la sua ontologia, la sua metodologia e i *case studies* con cui si è confrontata. A differenza delle prime tre, quest'ultimi sono arbitrari, nella misura in cui avrebbero potuto essere altri rispetto a quelli storicamente analizzati. Per tale ragione, nelle pagine seguenti, quando si parlerà di teoria ci si riferirà alla circolazione dell'azione tra i primi tre livelli, badando al mantenere un costante confronto con gli effettivi case studies in cui si è articolata. Da un lato, le relazioni intessute tra metafisica, ontologia e metodologia ricordano quelle delle bambole lignee in una matrioska: la metodologia è inscritta nell'ontologia, la quale, a sua volta, non può che articolarsi internamente a un panorama metafisico. Dall'altro, l'immagine più calzante è forse quella di un corso d'acqua: la fonte rappresenta la metafisica, il fiume l'ontologia e l'estuario la metodologia. La forza con

[1] In questo senso, ci si vuole distaccare dalle ormai classiche critiche portate all'ANT, come, per esempio: Amsterdamska (1990), Collins e Yearley (1992), Knorr-Cetina (1985), Schaffer (1991) e Shapin (1988). In quest'ultime, infatti, è lo scontro fra teorie diverse a dettare l'agenda del confronto; qui, non s'intende opporre i supposti benefici di alcuna teoria alternativa.

cui le acque si aprono la strada verso il mare dipende dall'impetuosità del fiume, ma non ci sarebbe nessun fiume in assenza di una sorgente. Il concatenamento che interconnette questi tre livelli è di norma stringente[2], e tale rimane anche nel caso dell'ANT. "To go from metaphysics to ontology is to raise the question of what the real world is really like" (Latour 2005, 117), poiché "metaphysics […] purports to define the basic structure of the world" (ivi, 50) e "ontology is the same thing as metaphysics, to which the question of truth and unification have been added" (ivi, 117).

Se la metafisica dell'ANT può essere espressa, in quanto "struttura di fondo", nei termini di un "gli esseri del mondo sono il risultato delle loro relazioni" (ovvero, l'essere-in-quanto-altro), passando sul piano ontologico queste relazioni ottengono un'articolazione maggiormente circostanziata, esigenza a cui Latour provvede utilizzando nozioni come quelle di esistenza in quanto azione/differenza, attore-attante, traduzione, ecc. Estesa la simmetria blooriana in una direzione più generalizzata[3], l'azione soggiacente alla produzione delle teorie scientifiche e di quelle sociali è la medesima, a prescindere dal fatto che a esercitarla siano umani o non, poiché il livello ontologico è unico: il collettivo, ovvero ciò che rimane dopo aver eliminato le artificiali "società" e "natura" (Latour 1991). Di conseguenza, gli esiti di una ricerca, sia essa scientifica o sociale, entrano a fare parte del collettivo che li ha prodotti alla stessa stregua ontologica degli attori che hanno contribuito a produrli. Questa è la sorte di ogni attante, possa esso essere classificato come naturale o sociale da quella modernità che agli occhi di Latour non è mai esistita. È un'ontologia caratterizzata dall'immanenza dell'azione esercitata nella fitta trama di relazioni mutevoli e occasionali. Non ci sono una fisica, una chimica, uno scienziato e degli strumenti sperimentali come cose reciprocamente separate ed esistenti in sé, e non c'è una teoria che cerchi di adattarsi più o meno goffamente a un mondo, ma attori che sono come, e in quanto, si danno in una specifica relazione. Si tratta di un'ontologia pragmatica, in cui le associazioni di umani e non-umani diventano percorsi conoscitivi del mondo perché lo generano con la loro azione reciproca *hic et nunc*.

In questo senso il pensiero dell'autore francese è in piena sintonia con alcune istanze del pragmatismo del secolo scorso, che ha lavorato per co-

[2] Seppure provenienti da un'impostazione filosofica esterna all'ANT, si vedano i lavori di Imre Lakatos, come per esempio il famoso Lakatos (1978) o Elie Zahar (1989).

[3] Latour non si accontenta di fornire ragioni analoghe per spiegare la costruzione tanto di teorie vere quanto di quelle false, ma estende la simmetria fino a creare un livello ontologico unitario, in cui la pretesa di spiegare la Natura per mezzo delle interazioni sociali (tra umani) svanisce a favore di un'interazione tra esseri per la quale il solo fatto che questi ultimi siano umani o meno cessa di costituire una differenza ontologica – si tratta di quel territorio che Latour (1991) definisce "Impero di mezzo".

struire dei ponti che potessero riunificare alcuni dei dualismi fino ad allora indiscussi, come quello tra scienza e mito (rito), teoria e pratica, fatti e valori, pensiero speculativo e analisi. Latour riunifica quello tra umani e non, così che i vari corpi disciplinari assumono le sembianze di una retroflessione contingente di questo continuo movimento, anch'essi in movimento. È tutto lì, anche nel senso che la forma assunta dagli attori "in azione" non è prevedibile a priori, ma si disvela nella sola contingenza. Una filosofia per la quale l'isolamento ideale delle essenze possa valere come nucleo grazie al quale individuare l'autentica natura di un essere, è poco più che fantascienza per Latour. Il corrispettivo metodologico di tale forma d'esistenza è ben espresso dal concetto di network: "network is a concept, not a thing out there. It is a tool to help describe something, not what is being described" (Latour 2005, 131). Il "qualcosa" che la nozione introdotta aiuta a "descrivere"[4] è esattamente l'ontologia di cui sopra. L'operazione appare alquanto ragionevole: fornirsi di strumenti d'indagine che siano adatti agli esseri studiati e, in questo caso, all'approccio empirico necessario all'antropologia. Per esempio, lo studio del destino che ha accompagnato la nascita della conformazione a doppio filamento del DNA (proposta da James Watson e Francis Crick) è passato dalle maglie del network composto da scienziati, laboratori, direttori di Dipartimento, autori dei manuali di genetica, et al.[5] più che dalla supposta conclusività degli esperimenti (Latour 1987). Ulteriore esempio lo si può trovare nel processo di pasteurizzazione (Latour 1984), in cui i "rapporti di forza" intessuti dalle relazioni del nascente network – pasteurismo, il movimento igienista, i medici, i microbi, i veterinari, le istituzioni socio-politiche, gli apparati militari, le esigenze coloniali et al. – vengono analizzati come costitutivi della nascita e diffusione del pasteurismo stesso, e con esso delle "nuove" caratteristiche del "mondo naturale".

2.1 Introduzione di una cesura nel pensiero di Latour

Il pensiero di Latour si è evoluto nel corso di diversi decenni, ragion per cui si rende necessaria una sua ripartizione al fine di permetterne una trattazione più circostanziata. I possibili "luoghi" in cui tracciare una linea di demarcazione sono molteplici, e rispondono alle contingenti necessità dettate dal tipo di analisi che s'intende operare: per esempio, John Law sceglie il 1990 come data di cesura, poiché mira a individuare "when actor network theory achieved recognizable form as a distintive approach to social theory" (Law 2009, 146).

Ai fini della presente analisi, il tratto essenziale è il poter sottoporre l'ANT a un'analisi riflessiva. Si porrà quindi un'ideale cesura nell'anno

[4] Si veda il par. 2 per un chiarimento sulle ragioni della virgolettatura.

[5] Si preferisce utilizzare "et al." anziché il canonico "ecc." per sottolineare la componete "autoriale" (leggi: attiva) di ogni attore presente nel collettivo.

2005, con l'introduzione sistematica dei modi di esistenza, d'ora in poi indicati come MoE (Latour 2006). Per i MoE, come per altri concetti, è certamente possibile individuare dei testi dedicati specificamente alla loro introduzione, ma generalmente non è che un modo per "fissare le idee" su un aspetto della teoria già in qualche modo presente e attivo. Per esempio, in (Latour 1999a) egli introduce il concetto di realismo costruttivista, ma il significato soggiacente al termine non è che una traduzione del senso ultimo già posseduto dai fatticci (Latour 1996), considerati "eventi"[6] che possono sottrarsi alle due alternative tradizionalmente offerte di "ostinarsi a durare" (come fatto oggettivo appartenente alla realtà esterna – realismo) da un lato o di "provenire dalla nostra psiche" (come costruzione che ha radici nella pura soggettività – costruttivismo) dall'altro, permettendo così di "sfilacciare […] la differenza tra fabbricazione e realtà, autore e creazione, costruttivismo e realismo" (Latour 1996, trad. it. 111).

L'anno 2005 viene quindi preso come utile spartiacque in quanto all'ibridazione del tutto con il tutto si affianca una regionalizzazione dell'ontologia che si dimostra più interessata allo stabilire dei confini che al varcarli. "À chaque mode correspondrait una ontologie locale et singulière exactement aussi originale dans ses productions que l'invention de la connaissance objective" (Latour 2006, 155). Le ontologie diventano regionali, tali da dare rilievo alle relazioni nel senso globale della costruzione della singola regione, e l'indagine si articola lungo i binari di uno studio degli "esseri della morale", "*esseri della politica*", ecc. ciascuno dei quali ha specifiche condizioni d'esistenza e una sua propria indipendenza: "Il y aurait des ÊTRES, oui de vrais êtres, que laisseraient dans leur sillage les passes, chaque fois singulières, des modes" (ibidem).

Con i modi d'esistenza[7], ovvero tali esseri e le loro tracce, l'attenzione si sposta sul versante di una tassonomia di possibili modalità epistemologiche degli esseri più che su una loro articolazione ontologica. La maggior parte dei attori/attanti non ha la possibilità di rientrare in tutti i modi di esistenza segnalati da Latour, e la teoria stessa di Latour non fa eccezione. Infatti, con l'introduzione di tale tassonomia dei MoE, essa perde il suo statuto ontologico di possibile attore interno a buona parte delle specifiche regioni d'esistenza, così che i connotati essenziali per essere sottoposta alla presente analisi vengono parzialmente a mancare. In buona sostanza, anche se la cesura del pensiero di Latour è stata introdotta in funzione degli specifici interessi del presente saggio, nondimeno coglie un aspetto effettivo nell'evoluzione della teoria: sotto specifiche condizioni

[6] "Evento" è un termine utilizzato da Latour per connotare un esistente in un senso contingente, in base al quale la polimorfia d'essere è determinata dalla molteplicità dei possibili hic et nunc relazionali; dunque, di nuovo, si tratta di un essere (attore o attante) intrinsecamente plurale.

[7] Per uno schema riassuntivo delle interrelazioni tra i differenti MoE si veda (Latour 2012, 484-485).

(quelle segnalate da Latour per i MoE) la teoria non è più passibile di analisi riflessiva.

3. "Far fare" vs "lasciar fare" e lo statuto della "descrizione occasionalista"

Il "far fare" ha un'area semantica compatibile con la costruzione[8], al contrario il "lasciar fare" allude più a uno spettatore neutrale e inattivo. Nell'idea del "lasciar fare" è implicita, seppur surrettizia, una mancanza di interpolazioni da parte di Latour in modo che i suoi report possano presentarsi come il più possibile "corrispondenti" rispetto a ciò che descrivono. In effetti, sembra essere il modo in cui egli cerca di "venire a patti" col problema della fallibilità dei report e, più in generale, di ogni forma di descrizione[9]: rendere la propria presenza evanescente per mezzo del "lasciar fare", così che lo scarto tra report e oggetto studiato possa ridursi al minimo, seguendo, suo malgrado, l'idea limite della "corrispondenza" tra i due.

Ma prima di proseguire con un confronto fra queste due istanze è necessario soffermarsi sullo statuto che assume la "descrizione" in un contesto occasionalista e di pura immanenza come quello latouriano. È un concetto che può godere a pieno titolo del diritto di cittadinanza in una tale filosofia? È dunque il caso di ragionare su una considerazione di Madeleine Akrich:

> In effetti, la descrizione, proposta dalla semiotica, del testo come rete di relazioni […] produce un effetto di simmetria caro ai sociologi delle scienze e delle tecniche: l'incomprensione e la comprensione sono sullo stesso piano, cioè non possono essere unilateralmente attribuite né a un lettore manchevole, né a un testo esoterico. Esse sono il prodotto di una relazione stabilita dal testo tra l'autore e il lettore, relazione che può essere, o può non essere, attualizzata; ciò che varia è lo scarto tra l'autore costruito dal lettore nel corso della sua lettura e l'autore "reale" (o, che è lo

[8] Qui, come nel resto del saggio, il termine "costruzione" viene utilizzato con il medesimo significato attribuitogli da Latour; si veda, giusto per citare uno dei molteplici esempi possibili, il commento di Latour alla fig. 4.1 (Latour 1999a, 130): "The ferment is constructed by Pasteur's hand and …[corsivo aggiunto]". I lettori che nutrono una certa allergia al termine "costruzione/ricostruzione" si sentano liberi di sostituirlo mentalmente con "assemblaggio/riassemblaggio".

[9] "the argument that all forms of description, report, observation and so on can always be under-mined. However, instead of using this argument ironically, as a way of characterising the work of others (scientists or other sociologists) while implying that our own recommended alternative is free from such deficiencies, we should accept the universal applicability of fallibility and find ways of coming to terms with it." (Latour e Woolgar 1979, 283).

stesso, lo scarto tra il lettore costruito dall'autore nel suo testo e il lettore "reale") (Akrich 1992a, trad. it. 424).

Dal punto di vista semiotico le distinzioni introdotte da Akrich tra "storia narrata', "autore" e "lettore" non solo sono utili per comprendere le dinamiche legate a un testo, ma anche interessanti strumenti su cui basare un'analogia metodologica per lo studio delle tecnologie. D'altro canto, traducendo la precedente citazione nei termini ontologici propri all'ANT, la fissità di un testo è sostituita dalla caleidoscopica apertura offerta da un'ontologia occasionalista e relazionale, per la quale ogni attore è anche autore all'occasione della relazione con un qualunque altro attore o attante. In altri termini, è la distinzione tra il piano della "storia narrata" da un lato e quello di "autore" e "lettore" dall'altro che viene meno: passando dalla semiotica all'ontologia, è iscritto nell'idea stessa di network che quest'ultimi siano attori allo stesso titolo di "quelli della storia"[10]. In tal senso, si può dire che se dal punto di vista semiotico l'estrazione di uno script (de-scrizione) d'azione (Akrich 1992b) è paragonabile alla trascrizione di una citazione da un testo[11] a un altro, sotto il profilo ontologico di un costruttivismo realista non sono possibili mere citazioni: ogni attore (che corrisponde alla "citazione" nella nostra analogia semiotica), una volta relazionato al nuovo co-testo (il network), non sarebbero più lo stesso; tale "impermanenza" si realizza non per via di una possibile e sempre aperta eterogeneità interpretativa, ma per ragioni squisitamente ontologiche.

Spostandosi dalla semiotica all'ontologia, perfino il piano dell'autore, così come del lettore, risultano indistinguibili tanto reciprocamente quanto dal livello della narrazione (che sul piano ontologico corrisponde a un network di relazioni). Tutti gli attanti di un network sono autori-attori di una "storia", che diventerà "altra" all'occasione di nuove relazioni. Se ne può evincere che la semiotica (il cui rilievo euristico nella formulazione della Sociologia della Traduzione resta fuor di dubbio) e l'ontologia non sono completamente sovrapponibili nell'ANT, nonostante la "materializzazione" cui viene sottoposta la prima. Attrezzati con una tale ontologia, diventa dubbio il senso in cui descrivere possa implicare una preoccupazione in merito alla corrispondenza[12], a meno che non si giudichi ragionevole, mi si passi un esempio un po' triviale, che un muratore finito di co-

[10] "Even as textual entities objects overflow their makers, intermediaries become mediators"(Latour 2005, 85).

[11] Latour ne scrive: "L'analista deve cogliere empiricamente queste situazioni [relazionali] per poter trascrivere gli script [corsivo aggiunto]" (Latour 1992b, nota 6).

[12] Il significato del termine stesso viene fagocitato dal senso più generale dell'ontologia ANT, entrando a far parte dell'area semantica legata alla nozione di circolazione costruttiva dell'azione: il riferimento, nelle catene di traduzione, è lungo tutta la serie di associazioni, come dire, dall'inizio alla fine in un sol colpo.

struire un muro si domandi se ha costruito proprio quel muro (in termini più familiari al lettori, suona come un Latour che si domanda, dopo aver riassemblato il sociale, se quello è proprio il sociale che ha riassemblato); descrivere la propria costruzione è equivalente al ricostruire la propria ricostruzione: operazioni che intrappolerebbero semplicemente in un regresso senza via d'uscita. In ogni ri-costruzione i "materiali impiegati" sono già parte della ri-costruzione stessa (perdendo lo statuto di materiali che stanno lì, inerti, in attesa di essere descritti). Se lo scorrere dell'azione lungo le maglie della rete dovesse interrompersi, sarebbe l'interruzione stessa a suggerirne una riedificazione, senza doversi appellare ad alcun neutrale "lasciar fare".

Con un costruttivismo realista non c'è più alcun in di alcun report che aspetti, con la neutralità di un contenitore vuoto, di essere riempito. In una prospettiva immanente, proprio a causa dell'effetto costruttivo esercitato da ogni attore (ricercatore incluso), anche da un punto di vista temporale vengono a mancare quel "prima" e quel "poi" che scandiscono il lasso di tempo durante il quale il "qualcosa" descritto debba rimanere "lì, quieto, in attesa di fare da test': è un'ovvia conseguenza del "far fare" connaturato a ogni attore. Le occasioni in cui Latour si riferisce al proprio lavoro come a una semplice "descrizione" priva di alcuna griglia interpretativa, che si limita a seguire gli attori lasciando che questi ultimi si presentino da se stessi[13], sono piuttosto numerose; qui voglio ricordarne due in particolare, poiché compaiono in saggi che l'autore stesso, insieme a Michel Callon (Latour e Callon 1992a) definisce i "manifesti ontologici" dell'ANT: (Callon 1986) e (Latour 1992b). Per quanto riguarda l'assenza di una "griglia interpretativa", Latour e Callon intendono l'interpretazione nel senso del carico teorico del soggetto osservatore, che, in una prospettiva immanente, non trova alcuna collocazione. Per quanto invece concerne il "lasciare" che gli attori agiscano, sembra confondere il "lasciar fare" con il "far fare", che è una caratteristica fondamentale del panorama attoriale dell'ANT. Con le sue parole:

> "we are now interested in mediators making other mediators do things. "Making do" is not the same thing as "causing" or "doing": there exist at the heart of it a duplication, a dislocation, a translation that modifies at once the whole argument" (2005, 217).

Latour ne esce come un Giano Bifronte, che con il volto del "teorico" rivendica il "far fare" come caratteristica ontologica[14], e con quello dello "sperimentale" invoca un "lasciar fare". Ponendo l'intera questione nei

[13] "Follow the actors themselves", dice ancora in Latour (2005, 61).

[14] "So, an actor-network is what is made to act by a large star-shaped web of mediators flowing in and out of it. It is made to exist by its many ties: attachement are first, actors are second" (Latour 2005, 217).

termini della nozione di performatività[15] così come viene utilizzata da Michel Callon – non così distante dal latouriano reciproco "far fare" tra attori – le "descrizioni" latouriane sono carenti dell'azione esercitata da tale caratteristica. Tale nozione è applicata da Callon allo studio delle scienze economiche per mettere in luce come esse giochino un ruolo essenziale nel costruire i mercati e l'economia stessi (propri oggetti di studio), così come questi ultimi influenzano le prime (Callon, 2006; Callon 2009). Mutatis mutandis, l'ANT con cui Callon studia le relazioni tra mercato e scienze economiche giocherà un ruolo essenziale nell'assemblarle, tanto sotto il profilo del "come" quanto sotto quello del "che", lasciando a quest'ultimo aspetto più spazio di quanto sia concesso da Latour. Infatti, egli è sostenitore dell'irreversibilità dei processi di traduzione: "With the irreversibilisation of translation and its normalisation we enter a world familiar to economists" (Callon 1991, 152).

In questo senso, quel poco di immutabile[16] che rende le "descrizioni" latouriane reciprocamente traducibili e "attrezzate di riferimento" svanisce. Se nella prospettiva di un costruttivismo realista è l'idea stessa di una corrispondenza più o meno veritiera di una descrizione a lasciare il tempo che trova, con Callon ne lascia ancor più; l'irreversibilità delle catene di traduzione rende la possibilità di tracciare il percorso compiuto dal riferimento più sfuggente che per Latour, da un lato inficiando l'intertraducibilità tra sistemi, ma dall'altro riconoscendo e integrando anche nella teoria quella polimorfica eterogeneità, insuperabile da alcuna corrispondenza (ancora possibili ordini del giorno nel contesto di un "lasciar fare"), che separa una (ri)costruzione da un'altra, un (ri)assemblaggio da un altro. Nel pensiero di Latour, il "lasciar fare" assume le fattezze di una sorta di postulato arbitrario – non è, infatti, né una conseguenza logica della teoria latouriana (a differenza del "far fare"), né una necessità imposta dall'esperienza –, attribuito a colui che compie l'azione del descrivere. Inoltre, l'introduzione di un "lasciar fare" traccia una pesante linea di confine fra la cognizione (rispetto alla quale una descrizione costituisce pur sempre un sottoinsieme), "distribuita" equamente come azione fra gli attori di un network (Latour 1986), e la descrizione, che risulta essere una prerogativa dei soli attori che "lasciano

[15] La storia di questo termine ha radici nella filosofia del linguaggio di John Langshaw Austin, il quale sostituisce al tradizionale modo di intendere il linguaggio quello della sua performatività: il linguaggio cede il passo all'atto linguistico. La "distruzione" del confine, ancora presente in Austin, tra linguaggio e "ciò che sta sotto" viene definitivamente superato in ambito semiotico grazie a quello che si definisce comunemente il "*semiotic turn*" (grazie a cui il contesto dell'enunciazione è incluso nell'enunciazione stessa) e negli STS dall'ANT, la quale inizia a prendere in considerazione "il materiale" che compone tale contesto; quest'ultimo è esplicitamente definito come "co-testo" (Latour 1988) per cercare di mettere un argine alla scivolosità della nozione.

[16] Si veda il par. 4 di questo articolo per la nozione di "mobile immutabile".

fare", come se ci fossero ancora dei fatti da cogliere fedelmente nella loro neutralità e non dei "fatticci" da riassemblare. D'altro canto, è ingiusto asserire una così netta demarcazione fra "azione" e "descrizione" nell'ANT considerata come teoria (a prescindere, quindi, dalla riflessività). Infatti, il Pasteur che descrive il suo esperimento sulla fermentazione appartiene a una concatenazione di "far fare" (Latour 1999a, 113-144), e così per i piani cartesiani che descrivono il moto di un punto su una superficie, per l'equazione che descrive un'iperbole, ecc. fino ad arrivare alle cosiddette leggi di natura, come per esempio le leggi della termodinamica o il processo di fermentazione.

Si pensi, per esempio, al primo capitolo di Pandora's Hope, in cui l'autore francese asserisce: "Yes, scientists master the world, but only if the world comes to them in the form of two-dimensional, combinable inscriptions" (Latour 1999a, 29). La raffigurazione di un'inscrizione bidimensionale prodotta dal team di botanici, biologi e geologi che Latour segue fino a Boa Vista la si può trovare in Latour (1999a, 57, fig. 2.15); essa consiste in una minuziosa descrizione[17] della parte di suolo presa in considerazione dal team di ricerca. È proprio il "far fare" di tutti gli attori/attanti coinvolti che conferisce valore a quella descrizione e un lavoro a Latour, essenzialmente grazie al trasporto del riferimento e al dipanarsi di un'azione che Latour può dunque seguire. In questo senso, quella descrizione non è avvenuta "lasciando fare", così come le fotografie e le mappe di quella stessa porzione di territorio che l'hanno preceduta e preparata.

Se le eterogenee forme di descrizione possibili rispondessero nel loro assemblarsi al semplice "lasciar fare", l'intera filosofia dell'azione latouriana, così come molti dei suoi report, non diventerebbero altro che una favolosa storia di fantasia: il "lasciar fare" calerebbe nel cuore stesso dei network, vanificando ogni tentativo di "seguire l'azione", quantomeno nella scienza, per… assenza d'azione. Le inscrizioni, guidate da un "lasciar fare", non eserciterebbero alcun lavoro di traduzione e trascrizione, perdendo d'un colpo valore, significato e riferimento. L'introduzione di un "lasciar fare", motivata dalla necessità di garantire una verosimiglianza dei report rispetto al loro oggetto d'indagine, sotto la lente di un'analisi riflessiva, porta paradossalmente alla conclusione opposta, nel senso che le descrizioni, così come le rappresentazioni (nel contesto immanente della filosofia latouriana), devono essere inestricabilmente legate a un "far fare" se pretendono di avere un valore in quanto legate a un effettivo riferimento; togliere il lavorio del "far fare" (trasformato in un "lasciar fare") implica bloccare il corso del riferimento, lasciandone i report latouriani privi. In questo senso, l'aver rilevato che tale "lasciar fare" è considerato da Latour alla stregua di una "personale" prerogativa è comunque da considerarsi una riduzione del danno, in quanto introduce sì una con-

[17] Nell'immanentismo di Latour una descrizione risulta essere una sottocategoria della rappresentazione, anch'essa subordinata al, e avvalorata dal, trasporto del riferimento.

traddizione, ma non depreda globalmente la teoria latouriana del suo valore.

Ragioniamo ora in termini semiotici e postuliamo per assurdo che il "lasciar fare" latouriano sia dovuto all'introduzione di un diverso livello enunciazionale (lo *shifting* del punto di vista di Latour rispetto al network oggetto di studio). Qualunque passaggio di qualcosa/qualcuno nell'inscrizione di quel qualcosa/qualcuno implica uno spostamento del punto di vista, talvolta più legato a specifici attori, altre volte più legato a determinati attanti (macchina fotografica, microscopio, ecc.). In questo senso, ogni "traduzione" (nel senso latouriano del termine) implica un diverso livello enunciazionale rispetto a ciò che traduce, a prescindere da dove riesca a trovare i materiali per la traduzione. Poiché una traduzione coincide con un diverso livello enunciazionale rispetto a ciò che traduce, in base alla nostra ipotesi non è guidata dal lavorio del "far fare", ma dal semplice "lasciar fare", e dunque non tradurrebbe alcunché. Ma ciò non può essere vero se la teoria di Latour ha un valore, quindi la nostra ipotesi deve essere erronea. In nuce, il "lasciar fare" avocato da Latour per i propri report è estraneo tanto all'ontologia quanto alla metafisica dell'ANT.

4. Immobilizzato nella rete

> "But, […] did ferments exist before Pasteur made them up?" There is no avoiding to answer: "No, they did not exist before he came along", an answer that is obvious, natural and even commonsensical! (Latour 1999a, 145).

Il fermento, nella sua esistenza relativa determinata dall'insieme di relazioni tra gli attori del collettivo che lo ha posto in essere – quello di Pasteur e della sua teoria sulla fermentazione – non poteva esistere prima dell'esistenza di quel collettivo (quindi, per esempio, non come fenomeno di matrice vitalistica[18]), in piena sintonia con l'immanentismo latouriano.

[18] Per Pasteur, infatti, i fenomeni della fermentazione erano inestricabilmente legati a fattori di origine vitalistica. Con le sue parole: "Nel corso di questa memoria ho ragionato nell'ipotesi che il nuovo lievito sia organizzato, che sia un essere vivente e che la sua azione chimica sia correlativa al suo sviluppo e alla sua organizzazione." (Pasteur 1858, trad. it. 175). Nel panorama scientifico dell'epoca possiamo enumerare, tra le teorie ad essa antagoniste, la tesi sostenuta da Justus von Liebig e quella proposta da Jöns Jacob Berzelius. Per quest'ultimo la fermentazione è il risultato di un'azione di contatto e ne nega ogni connessione con l'eventuale presenza di organismi viventi nel lievito. Per Liebig, invece, di per sé la materia non possiede alcuna attività, che, al contrario, può esservi introdotta grazie al sopraggiungere di energia (meccanica, termica, ecc.) dall'esterno; in tal modo si avvia un processo di decomposizione i cui residui vengono additati come i responsabili della fermentazione. Per una discussione più approfondita, si veda (Verona 1972), in particolare l'introduzione alla sezione "Fermentazioni".

Prima di allora, però, "altri" fermenti godevano d'esistenza, occasionata delle associazioni all'interno delle quali risiedevano, per esempio, con i processi di decomposizione in un caso, o con la generazione spontanea di Pouchet in un altro. Il reciproco scarto tra questi ultimi due, così come dal fermento "pasteuriano", non risiede certo in una differenza inscritta in una qualche fantomatica essenza, ma negli attori e attanti coi quali si articolano reciprocamente, gli stessi che[19] "fanno fare":

> Latour give us not just a metaphysics of actors, but of actors that come to birth only on the occasion of their associations; since these associations shift constantly in both tiny and revolutionary ways, we have actors that perpetually perish rather than endure. (Harman 2009, 80).

A fronte di una tale metafisica e di tutto il rilievo che assume l'azione a essa intrinseca, si ritiene sia preferibile l'espressione ontologizzazione piuttosto che ontologia, poiché il primo termine restituisce quel senso dinamico, attivo e mutevole connaturato agli esseri dell'ANT cui il secondo non rende giustizia. Lo si considera inoltre più adatto a trasportare quel senso di caleidoscopica esistenza immanente che caratterizza ogni attore e attante che è-in-quanto-altro. Come dice Latour stesso:"Every change in the series of transformations [nel susseguirsi di attori reciprocamente relati nel network] that composes the reference [che compone, per esempio, il fermento] is going to make a difference, and differences are all that we require" (Latour 1999a, 150), poiché ogni essere non può considerarsi ontologicamente separato dalle sue relazioni. Infatti: "each element is to be defined by its associations and is an event created at the occasion of each of those associations" (ivi, 165).

Con "each element" Latour si riferisce a ogni attore e attante, che, proseguendo con l'esemplificazione, può essere riferito alla nuova teoria del nuovo Pasteur e al nuovo essere, il fermento vitalistico. Poiché ogni cambiamento nelle associazioni che assemblano un collettivo ha come necessario portato il trovarsi di fronte a un differente collettivo, il network dispiegato da Liebig, che non è Pasteur, che non lavora a Lille, ecc., pone in essere una fermentazione nelle vesti di "residuo" di un processo chimico, un attore evidentemente diverso da quello creato dalle relazioni del network pasteuriano. Riflessivamente, se il fermento è una realtà diversa come attante di differenti collettivi, poiché associato a esseri di volta in volta eterogenei – esito che Annamarie Mol (2002) mette chiaramente in evidenza, arrivando a parlare di realtà differenti ma "conviventi" – l'attore ANT, nell'assemblaggio delle numerose reti di associazioni di cui ha fatto parte agendo le rispettive ri-costruzioni dei "suoi" *case studies*, dovrebbe essere almeno tanto eterogeneo quanto l'insieme di diversi attori in cui di volta in volta si trova. Meglio ancora, non dovrebbe proprio

[19] Col termine "che" s'intende esprimere la duplice direzione dell'azione in un network: "a cui" e "i quali".

trattarsi dello stesso attore, così come i fermenti dei diversi laboratori di Pasteur, Liebig o Berzelius. Invece, *Pandora's Hope*, così come *Reassembling the Social,* giusto per fare qualche esempio, sono testi in cui per circa 300 pagine Latour spiega la sua teoria attingendo alla moltitudine di *case studies* a cui l'ha applicata[20]. Detto altrimenti, da un'enorme quantità di collettivi, e quindi da un caleidoscopio di diversità relazionali fra attori, risulta un unico e inamovibile attore nella misura in cui l'azione che esercita sugli esseri che studia non trova il corrispettivo simmetrico dell'azione da essi esercitata sull'ANT stessa.

Vale la pena ricercare nel pensiero di Latour l'eventuale presenza di concetti che giustifichino tale asimmetria rendendola solo apparente. Innanzitutto, una riflessione sulla terminologia. Latour usa talvolta in modo interscambiabile "perdurare" ed "esistere", ma le rispettive aree semantiche si sovrappongono solo in parte. Infatti, "perdurare" può implicare una costanza nella forma che invece esistere non sottende, tant'è che i due termini diventano sinonimi nel solo caso in cui al perdurare si aggiunga l'espressione: "nell'esistenza". Quanto viene qui messo in discussione, è proprio la costanza della forma dell'ANT, non il fatto che esista, o che possa esistere, da lungo tempo. Latour (1987) scrive di catene lunghe e corte per spiegare il nascere di nuovi attori e delle "prove di forza" che essi hanno dovuto affrontare per resistere.

È forse nella grandezza del network da cui nasce l'ANT che va ricercata una giustificazione del suo monolitico perdurare? Non sembra. Si prendano attori come l'atomo. Il primo esiste dai tempi di Democrito, e nel network dell'antica Grecia esso aveva la forma di materia, in opposizione al vuoto: essere in contrapposizione al non-essere. Nella fisica di fine Ottocento e inizio Novecento ha invece assunto la forma del "costituente ultimo" della materia e pure di quel "vuoto" che in Democrito rappresentava l'opposto dell'essere. Nella fisica del Novecento rimane uno dei costituenti della materia, ma non più il suo tassello più minuto. Grazie alla ricerca compiuta da fisici di fama mondiale come Enrico Fermi, Robert Oppenheimer, Edward Teller e molti altri assume la forma d'esistenza di una potenziale arma[21]. Con Ludwig Wittgenstein, uscendo quindi dai network interni alla fisica, "rinasce" come atomo logico, o fatto atomico. Seppure "l'atomo" sia nato in uno specifico network più di duemila anni fa (un esemplare di resistenza e durevolezza!) il suo relazionarsi con differenti network ne provoca una mutazione, come è ovvio che sia anche in base all'occasionalismo Latouriano. D'altro canto, col concetto di *black box* Latour (1987) intende catturare quella permanenza

[20] Così si esprime Latour in merito alle teorie e ai loro oggetti: "objects and knowledge of objects are similarly thrown into the same Heraclitean flux." (Latour 2006, 5). Si veda anche Latour (2009a, 24-25).

[21] Non v'è dubbio che quest'affermazione sia "tagliata con la scure", ma ai fini del presente saggio è sufficiente, poiché è all'interno di un nuovo network che l'atomo arriva ad assumere una tale valenza, inesistente prima di tali relazioni.

"transnetwork" che può caratterizzare un attore in un dato periodo storico: una volta formatosi e affermatosi, avendo quindi superato un gran numero di prove di forza, esso si diffonde entrando a far parte di una moltitudine di network – si pensi, per esempio, alla legge di gravitazione universale – mantenendo la medesima formattazione. Nella visione di Latour, questo accade perché l'attore viene accettato senza più essere messo in discussione nemmeno dalla comunità di pertinenza (per esempio, il Dna in genetica, le cellule in biologia, ecc.). Segue che nel concetto stesso di *black box* risiede un'indebita sovrapposizione del piano ontologico con quello epistemologico: una questione è la credenza o meno in un esistente, tutt'altra è l'esistere dell'esistente stesso.

Far dipendere la formattazione ontologica di un attore (in questo caso una sua stabilizzazione) non più dal suo *hic et nunc* relazionale, ma dal fatto che "ormai ci si crede" oppure "ormai è diffuso" significa introdurre una forma di irrealismo ancora più spinta di quella, per esempio, di un Nelson Goodman (per il quale, quantomeno, le forme di credenza sono rigidamente subordinate a delle prove empiriche fondate su una rilettura del processo induttivo in base alla pratica del trinceramento[22]). In questo senso, il concetto di *black box* introduce una trascendenza internamente all'immanenza relazionale dell'ontologia latouriana; al contrario, se ci trovassimo, per esempio, sul terreno di un costruttivismo di matrice soggettivistica, un'operazione come quella suggerita dall'idea di *black box* non rappresenterebbe alcuna trascendenza internamente alla propria ontologia. Per tali ragioni, non è possibile considerare quanto Latour (1987) sostiene una soluzione al problema sollevato in questo paragrafo e nel successivo.

4.1. L'immobilità perdura: la storicità della cosa

Sia dato il collettivo di un caso storico[23] (per esempio, quello di Pasteur e del fermento), e si ponga ABCD al tempo1 per indicare la catena relazionale tra attori che ne definiscono la connotazione; nel momento in cui si aggiungesse un ulteriore attore E, per esempio l'ANT (che, come esito della sua analisi, produce una nuova narrazione del caso storico), il collettivo, stando al Latour di *Pandora's Hope*, diventerebbe additivamente ABCDE al tempo2. Mutatis mutandis, un altro collettivo, diciamo GTRQ, diventerebbe GTRQE. Ma se un attore è E prima di immergersi in nuove relazioni e continua a essere E successivamente, si trasforma, senza azione alcuna, in una sorta di primitivo indipendente da esse. Godrebbe di un'esistenza speciale, indipendente dalle relazioni contingenti in cui è inserito, e costituirebbe un'eccezione ontologica a quell'ontologizzazione connaturata a ogni attore cui si è accennato nel terzo

[22] Per il concetto di triceramento si veda Goodman (1955).

[23] Si veda Latour (1999a, cap. 5), per il concetto di "storicità della cosa" in relazione all'ANT.

paragrafo. Alternativamente, poiché non agisce né è agito, semplicemente non esisterebbe in un collettivo immanente e relazionale. Come sostiene Latour, se ogni attore in più, in meno o semplicemente altro produce una differenza, e "le differenze sono tutto ciò di cui abbiamo bisogno", il rapporto tra attori non può essere semplicemente additivo neppure rispetto a quelli denominati ABCD (o GTRQ) nel precedente esempio, poiché gli "addendi" stessi immersi in nuove relazioni non saranno più gli stessi: avviene una modificazione dell'esistenza relativa degli attanti del collettivo. Come dice Latour: "l'azione è tutto ciò che serve", ovvero l'azione che ogni attore esercita su quelli con cui entra in associazione e da cui è altrettanto agito. Per la semiotica materiale gli attori che non esercitino una tale azione non sono nemmeno da considerare come esistenti, rendendo l'esistenza stessa (e le sue modalità) un portato delle influenze relazionali che si dispiegano all'interno di un network:

> there is no other way to define an actor but through its action, and there is no other way to define an action but by asking what other actors are modified, transformed, perturbed, or created by the character that is the focus of attention. (Latour 1999a, 122).

Mutando la precedente esemplificazione alfabetica in una matematica, al tempo1 si darebbe il collettivo 5+2+3(=10) e al tempo2 5+2+3+6(=16): l'aggiunta del nuovo attore (il 6) causa, per come Latour enuncia il concetto di storicità delle cose, una modificazione dell'attante che si trova all'estremità della catena di traduzione (il risultato polare, che nel nostro esempio matematico corrisponde alla somma: il 10 diventa 16), ma non degli altri con cui pure entra in relazione, e, cosa ancor più rilevante, neppure di sé (come mostrato nel precedente paragrafo). Quantomeno, sembrerebbe che Harman (2009, 114). non manchi il bersaglio quando afferma: "for Latour, an actor is defined by its current alliances – but this does not mean that it has no problem entering new ones!".

5. ANT e relatività

Latour (1987) introduce l'espressione "mobile immutabile" al fine di indicare il trasporto di un attore in un altro senza deformazioni, ma per mezzo di massicce trasformazioni; e continua a servirsene fino a scritti più recenti (Latour 2012). Nel 1999 lo identifica con quelle relazioni stabili – in cui risiederebbe l'immutabilità a fronte di altre, al contrario, mobili – che a partire dalla loro presenza in un attore-network possono essere trasportate passando per le più disparate inscrizioni[24]; sono quest'ultime a

[24] Nel glossario a conclusione di (Latour 1999a), la voce "mobile immutabile" rimanda proprio a quella d'inscrizione.

permetterne la mobilitazione e l'articolazione (Latour 1999a). Un testo interessante verso cui volgere lo sguardo per un'analisi della nozione di "mobile immutabile" è *A Relativistic Account of Einstein's Relativity* (Latour 1988), poiché lo si trova in associazione ad attori assai simili ad esso, seppur appartenenti a un'altra disciplina: le trasformazioni fisiche (da quelle galileiane passando per quella di Lorentz fino al "mollusco" della Relatività Generale, seppure a quest'ultimo sia dedicato uno spazio minimo), grazie alle quali è possibile parlare di relatività. È nella contrapposizione di quest'ultima al relativismo che la nozione ossimorica di "mobile immutabile" acquisisce tutto il suo rilievo e diviene un elemento obbligato per il passaggio verso quella "relatività sociologica" che in sua assenza non sarebbe possibile, così come quella fisica in assenza delle trasformazioni. In particolare, il tentativo di applicare il concetto di "mobile immutabile" all'ANT stessa permette di illuminare sulle possibili ragioni del comportamento contradditorio che la teoria assume nella veste di attore della propria ontologia (si veda il par. 3) e di ritagliare un terreno più circoscritto all'estensione della "relatività sociologica". "We are no more relativist that Einstein, and for the same reasons" (Latour 1988, 26).

L'obiettivo di fondo che Latour (1988) si prefigge è quello di riformulare l'argomentazione einsteiniana (Einstein 1920) passando per un'analisi semiotica del testo, in modo tale da importare nelle scienze sociali una distinzione altrettanto chiara tra relativismo e relatività; in questo senso, è guidato dall'idea che introducendo dei network materiali si possa restituire quel significato unitario alle osservazioni che il relativismo avrebbe brutalizzato. Nel corso del saggio si possono seguire (poiché ritracciate da Latour) una serie di sovrapposizioni in cui gli spostamenti (*shifting*) in e out del narratore o del riferimento rispetto all'autore sono equiparate ai cambiamenti del sistema di riferimento (d'ora in poi semplicemente SR, che diventerà SRI, in cui "I" sta per inerziale, parlando di Relatività Ristretta) dal quale può avvenire una qualsiasi osservazione. "Away from the work of inscriptions, subscriptions and transcriptions, no shifting in and out would be possible. We would be limited to a point" (Latour 1988, 31), ovvero, saremmo limitati a osservazioni (o punti di vista narrativi per la parte di analogia con cui si rifà al cosiddetto "*semiotic turn*") in cui l'*hic et nunc* in cui avvengono diventerebbe la soglia oltre la quale non sarebbe possibile volgere lo sguardo. In buona sostanza, l'equivalenza delle osservazioni operate da SRI eterogenei, nonostante le differenze nelle misurazioni compiute all'interno dei rispettivi SRI (contrazione delle relazioni spaziali e dilatazione di quelle temporali), grazie all'invarianza garantita dalle trasformazioni di Lorentz e passando per un'analogia semiotica, trova un suo equivalente nell'ANT. Così come rendere commensurabili le misurazioni fatte da SR diversi restituisce un significato unitario alle leggi della fisica, il "poter passare" da una descrizione a un'altra senza "perdere" il riferimento rende significanti le osservazioni degli scienziati sociali. Per quest'ultimi, sono i network e i "mobili immutabili" a farsi garanti dei possibili spostamenti.

> It is to accommodate many examples of such a problem that I have proposed considering history of science as the history of centres which are growing through the management of traces that have tree main characteristics: they are as mobile, as immutable and faithful, and as combinable as possible. The circulation back and forth of these "immutable mobile" trace networks – that is to say, two-way paths leading from the centre to the now-dominated frames (Latour 1988, 21).

È quindi possibile raccogliere e sovrapporre le tracce degli attori grazie alla possibilità di spostarsi tra sistemi "ora dominati" (ora che anche la sociologia è diventata relativistica); d'altro canto la sociologia "domina" i propri sistemi grazie alle tracce che le permettono di muoversi dall'uno all'altro. Grazie alla circolazione del riferimento lungo le catene di attori che lo traducono, le tracce di tale riferimento permangono nella forma di una relazione che rimane stabile pur scorrendo da un attore a un altro. Così come tale immutabilità viene preservata tra il riferimento e la sua descrizione – seppur nella forma di poche o una sola relazione a fronte delle tante che costituivano quell'attore-network – altrettanto accade nello "spostarsi" tra diverse descrizioni di "uno stesso" riferimento, comprese le descrizioni che si sono sovrapposte lungo l'evolversi della storia della scienza.

Il passaggio dal relativismo alla relatività sta tutto nell'aver defalcato la chiusura interpretativa di una singola descrizione, innanzitutto non chiudendo l'interpretazione negli abissi di una soggettività mai completamente comprensibile e comunicabile, e in secondo luogo "distribuendola" tra gli tutti gli attori del network, rendendo così le differenti prospettive commensurabili, poiché il riferimento permane rintracciabile a fronte della pluralità delle possibili traduzioni. In questo senso, l'ANT, tornando al paragone con la relatività einsteiniana, non coincide con un SR (ovvero, con un semplice punto di osservazione), ma da un lato con la teoria della relatività tout court (con il mondo relativistico), e dall'altro con le trasformazioni di Lorentz (ovvero il mezzo utilizzato dalla teoria per gli "spostamenti"). La metafisica dell'ANT, proprio come ogni metafisica, definisce il mondo e i suoi elementi[25], mentre la sua metodologia fornisce gli strumenti per potervisi muovere all'interno e far agire le catene di traduzione. In altri termini, al di fuori dalla sua specifica metafisica non vi sarebbe alcuna realtà attoriale (ovvero attori occasionati dall'azione circolante in un network) da tradurre, e in assenza del suo metodo le mancherebbero gli strumenti per agire alcuna traduzione e per relazionarsi ad alcun attore.

[25] In particolare, si veda Latour (2005, 51) per una dichiarazione esplicita e sintetica: "[…] actors engage in the […] metaphysical constructions by redefining all the elements of the world".

Tornando al concetto di "mobile immutabile", è ora chiaro che "il mobile" pertiene a una prospettiva (così come in Relatività Ristretta una trasformazione delle misurazioni spaziali e temporali di un oggetto è legata al SR dal qual viene operata), ovvero a un punto di vista dal quale viene effettuata la traduzione di alcune relazioni caratterizzanti il riferimento (l'immutabile). La ragione più significativa dell'inapplicabilità di tale concetto all'ANT stessa in veste di attore risiede nel fatto che nessun attore è un mobile immutabile in sé così da potersi autoperpetuare, ma diventa tale solo rispetto al SR dal quale viene ricostruito (non si utilizza il termine "descritto" per le ragioni addotte nel paragrafo 2). In questo senso, l'ANT è un mobile immutabile dal punto di vista della presente ricostruzione, ma non è possibile lo sia dal punto di vista dell'ANT in se stessa.

Stando così le cose, "in sociologia" è possibile mantenere la permanenza del riferimento a fronte dei molteplici punti di osservazione a patto di abitare il mondo latouriano e di applicare i suoi metodi, così come in Relatività Ristretta è possibile considerare equivalenti le rilevazioni metrologiche eterogenee provenienti da differenti SRI a patto di abitare il-/credere nel mondo dell'elettrodinamica dei corpi in movimento e di utilizzare il suo metodo (trasformazioni di Lorentz). Quindi, affinché in sociologia sia possibile la relatività del punto di vista (ovvero sia possibile "travel from one frame of reference to the next, from one standpoint to the next"[26]) è necessario che questi punti di osservazione siano iscritti all'interno del mondo latouriano e ne condividano la metafisica[27].

Riconoscendo l'azione esercitata dal più generale livello metafisico, diventa quindi chiaro il perché di quella paralisi in cui incorre l'ANT considerata come attore circolante nella propria ontologia (si veda il par. 3): a causa della relazione che quest'ultima intrattiene con metafisica e metodologia, da un lato è immobilizzata dalla prima e dall'altro dalla seconda. Proprio come la Relatività non sarebbe senza un mondo e un metodo relativistici, così l'ANT non sarebbe senza l'essere-in-quanto-altro e i suoi metodi. La differenza macroscopica risiede nel fatto che la prima non corre il rischio riflessivo di comparire nella propria ontologia. Siano concesse due righe di fantascienza per chiarire il punto: la Relatività Speciale vista da un SRI con moto prossimo a quello della luce apparirebbe "deformata", e con essa anche le trasformazioni di Lorentz, che, dunque, la "trasporterebbero" in un SRI completamente altro rispetto a quello prossimo alla velocità della luce dal quale sarebbe osservata, perdendo

[26] Caratteristica che Latour (2005, 146) considera condizione *sine qua non* per potersi definire uno scienziato.

[27] Qui l'analogia con la semiotica s'interrompe. Se, infatti, per quest'ultima qualunque *shifting-out* rispetto a un piano narrativo che sia concepibile è possibile – compreso quello in un altro testo (Latour 1988) – spostandoci sul livello ontologico sono realizzabili soltanto quelli che rimangono interni al mondo relazionale e occasionale; all'esterno di quest'ultimo, rimanendo in una prospettiva immanentista, sarebbero shiftati verso il non-essere-più del network.

d'un colpo teoria e mondo relativistici[28]. Questo per dire che in relatività, a fronte dell'enorme libertà di movimento dell'osservatore c'è qualcosa che deve rimane sempre e comunque fisso (il mondo relativistico e le trasformazioni di Lorentz, nel caso della Ristretta) perché si possa parlare di relatività e non di relativismo; nell'ANT sono la metafisica e il metodo, così che quando l'ANT circola in qualità di attore nella propria ontologia subisce l'azione "fissatrice" di entrambe queste sue due istanze interne. Se per l'esistenza degli attori il termine più adatto a renderne la polimorfia è "ontologizzazione", all'attore ANT è più propria la "quiete ontologica". Fortunatamente, le operazioni empirico-cognitive in cui sia necessario un nesso di coerenza tra teoria in generale e la teoria stessa come parte della propria ontologia sono piuttosto rare (nelle scienze naturali, per esempio, non ve n'è traccia). Cionondimeno, nei casi in cui tale nesso sia richiesto, ed è il caso dell'ANT rispetto al proprio immanentismo, il rispettarlo diventa una necessità cogente affinché, come dice Bloor, una teoria non rappresenti la costante confutazione di se stessa.

6. Un modo di esistenza per i modi di esistenza?

> Pour les êtres de la fiction, tout, même la nature, même le droit, même la science, est occasion d'esthétiser. Mais pour la religion, tout, même l'organisation, même la morale, même la nature, n'a d'autre but que de "chanter la gloire de Dieu". Ei, bien sûr, pour la connaissance, tout doit se plier aux exigences de ses chaînes de référence, tout, même l'habitude, même la religion […] (Latour 2012, 478-479).

Ciascun essere appare il centro di una nevralgica stratificazione dei modi di esistenza, ai quali è possibile "dare (o meno) vita" seguendone empiricamente la circolazione lungo le eterogenee articolazioni. Non c'è alcun essere – in sé – che attenda, in un impossibile al di sotto delle sue specificazioni multimodali d'esistenza, qualcuno che lo sveli:

> Non, il y a une fonction, une dignité ontologique du voilement, que l'on peut rater de deux maniere. Premièrement, en voulant accéder directement aux choses "dévoilées" – on ne tomberait au mieux que sur des réseaux d'associations dénués de leurs différences, ou sur des différences de tonalités, les prépositions dénuées de trjectoire, de suite, de réseaux; deuxièmement, en résignant définitivement à n'avoir affaire qu'à des apparences sans jamais plus rechercher "ce dont" elles seraient les apparences. (Latour 2012, 273)

[28] Nell'esempio si scrive di "velocità di un SRI" al solo fine di conseguire un'immediatezza esplicativa, poiché in relatività le uniche velocità possibili sono quelle, appunto, relative tra SRI.

È il "velo" ad assumere importanza modale, poiché intessuto di quelle associazioni, differenze e alterazioni dell'essere sotto le quali non si troverebbe che un vuoto ontologico, laddove, al contrario, un'analisi delle sue modalità (che vengo a coincidere con la molteplicità dell'essere) è in grado di indicare lo specifico terreno in cui ogni essere esiste. Possedendo ogni MoE una propria ontologia regionale (ciascuna di eguale dignità[29]), rispetto all'appartenenza a quest'ultima sono le condizioni di esistenza (dette anche di felicità) a decretarne la possibilità o meno: "l'essere, il non essere o il non essere più". Che ogni modo possa comprendere tutti gli altri – tradotto nella prospettiva dell'essere utilizzata da Latour diventa: ogni essere può articolarsi in più modi, al di sotto o al di là dei quali semplicemente non è – non vuol affatto rivendicare una potenzialità in attesa di una sua attualizzazione, ma una condizione dell'essere per la quale una pluralità di modi sono presenti, e si esplicitano a seconda delle catene di associazioni che passano per "la cosa" presa in esame. La possibilità di selezionare le associazioni pertinenti a ciascun modo permette di definire confini più netti, poiché più circoscritti, all'insieme di relazioni verso cui volgere lo sguardo nello studio di un attore di quanto riuscisse a fare l'ANT, risolvendo, almeno in parte, il problema della nebulosità dei loro limiti estensionali[30].

Il network stesso diviene uno tra i possibili modi d'esistenza ([RES] = reseau), caratterizzato dallo studio della moltitudine di catene d'associazioni che attraversano le diverse frontiere disciplinari. A differenza dei restanti MoE, quello [RES] è l'unico in cui il "che" di un attore coincide con il suo "come", nella misura in cui ricostruire la rete di associazioni che genera (e rigenera all'occasione di nuove relazioni) un attore implica il conoscere in che modo quest'ultimo è. Risulta essere il solo modo di esistenza in cui l'idea del "tutto collettato con tutto" (Latour 1999b) sia ancora "alla giuda" della metodologia di analisi.

In questo senso, epistemologia e ontologia non sono sovrapponibili nei restanti modi di esistenza, così come non lo sono ontologia e semiotica. Quando Latour (2002; 2012) si dedica allo studio della legiferazione operata dal Consiglio di Stato francese, le condizioni di felicità di un essere del diritto sono rappresentate dalla sua continuità (*rattacher*) col preesistente corpus del diritto, ovvero dalla coerenza di ogni nuova deliberazione della giurisprudenza con le precedenti. Se l'ingresso di una nuova norma, in quanto enunciato, all'interno del corpus della giurisprudenza richiede "la sola" continuità con l'insieme di segni giuridici codificati preesistente (Latour 2002), in quanto attore la sua esistenza può trovare radici in una più ampia rete di associazioni. In questo senso, le ragioni ontologiche di un attore (nel nostro esempio, della giurisprudenza) ecce-

[29] "Mais il a saisi le point essentiel: les modes d'existence sont tous d'égale dignité". (Latour 2009a, 15).

[30] Si veda, per esempio, Latour (1999b). Una soluzione metodologica la propone Michel Callon (1991).

dono quelle semiotiche. Perché sia dicibile come enunciato appartenente alla giurisprudenza deve adempiere alle condizioni di felicità individuate, ma perché sia esistente come attore il suo circolo di associazioni può ben eccedere quelle della giurisprudenza.

Si pensi, per esempio, al caso Stamina italiano, sul quale i giudici si sono da poco espressi, pronunciando la sentenza di un anno e dieci mesi di reclusione per Davide Vannoni, salvo l'aver accettato la richiesta di patteggiamento avanzata dai legali di quest'ultimo; altri coinvolti nelle vicende Stamina, come il direttore dell'Ires Piemonte Marcello La Rosa e l'ex dirigente Aifa Carlo Tomino, sono stati rispettivamente condannati con giudizio abbreviato a due anni e a sei mesi. Altri quattro imputati degli Spedali Civili di Brescia, come per esempio l'ex direttore sanitario Ermanna Derelli, sono stati rinviati a giudizio e per loro il processo si riaprirà nel 2016. Tali deliberazioni hanno dovuto passare per una molteplicità di modesti movimenti civici, la medicina, le provette, gli ambulatori, diverse malattie degenerative, numerosi casi di sofferenza umana, il MIUR, ecc., e questa fitta rete di relazioni ha portato alla loro nascita ontologica; tant'è che il procuratore Raffaele Guariniello commenta in merito: "Ha trionfato la giustizia e anche la scienza" (Italiano, 2015), sottolineando proprio come il "venire al mondo" di tali sentenze sia legato a una serie di fattori indipendenti dalle regole del diritto (in questo caso fa riferimento alla scienza). Sulla medesima strada si colloca il commento dei legali di Vannoni: "La giustizia ha fatto il suo corso, ma la scienza ancora no. Ci sono studi in corso sulla medicina rigenerativa […] Se ciò fosse, non escluderemmo un ricorso per ottenere una revisione di questo processo" (ibidem); quanto l'avvocato effettivamente sottolinea nella sua dichiarazione è la stretta dipendenza ontologica di tale sentenza da fattori esterni alla giurisprudenza, e a tal punto ne dipende da poterne ricevere una revoca ontologica. Perché, invece, quella sentenza sia un enunciato della giurisprudenza (ovvero adempia alle condizioni di esistenza del modo [DRO]), dovrà, secondo Latour (2012), "semplicemente" mantenere una continuità col precedente corpus dottrinale. È questo il caso, per esempio, dei criteri utilizzati per decidere a quali pazienti somministrare il metodo Stamina nella sentenza depositata il 5 dicembre 2014 dalla Corte del Tribunale di Taranto: "il d. l. n. 24 del 2013, come convertito dalla legge n. 57 del 2013, privilegiando principi di continuità terapeutica ed esigenze di non interferenza con provvedimenti dell'autorità giudiziaria, ha quindi consentito la prosecuzione dei trattamenti con cellule staminali già "avviati" o già ordinati da singoli giudici"; quanto importava era la coerenza rispetto al d. l. n. 24 e la non-contradditorietà rispetto alle decisioni prese antecedentemente da altri giudici (Redazione quotidianosanità.it 2014).

Se in un network conoscere il "come" contingente di un attore coincide col conoscere il suo essere immanente *hic et nunc*, con la rigida regionalizzazione dell'ontologia esposta, Latour (2012) separa le associazioni

che portano all'esistenza un attore da quelle che permettono di esprimersi sulle possibili modalità epistemologiche di tale attore.

7. Conclusioni e inizio di una "nuova" azione

Nel paragrafo introduttivo si è accennato al terzo livello (riflessivo) costituito dalla presente ricerca: studiare con gli strumenti dell'ANT l'ANT come attore dell'ontologia articolata dall'ANT stessa. Ora è venuto il momento di prendere in considerazione tale livello in relazione ai limiti individuati, per valutare se essi sortiscano o meno un effetto "a cascata" tale da coinvolgere anche la presente analisi e in che misura. Laddove in quest'ultima si prendano le distanza da alcuni specifici aspetti della teoria latouriana, sarà implicito l'auspicio che ciò possa avvenire anche per l'ANT stessa.

Nel secondo paragrafo è stato argomentato come il "lasciar fare" avocato da Latour sia non solo anomalo rispetto alla teoria, ma anche contradditorio relativamente alla teoria come attore della propria ontologia. In relazione ad esso, si è valutato quanto l'idea di poter operare delle pure descrizioni nel contesto dell'ANT sia poco più che una chimera. In tal senso, questa ricerca passa per una ri-costruzione (non una mera descrizione) del pensiero latouriano, in cui il fluire dell'azione – compresa quella dello scrivente – richiede una circolazione interna (per via dell'impostazione riflessiva) all'ANT sottoposta al vincolo di non essere interrotta. In quanto all'ANT antecedente alla presente ri-costruzione? Se ne possono trovare tracce trasportate e trasformate; la speranza d'incontrare il dato neutrale che non abbia altro da fare se non attendere pazientemente di essere colto e confrontato con la propria descrizione è stata lasciata "fuori dal cancello" per via della prospettiva adottata: quella dell'ANT!

Nel terzo paragrafo si è constatato come l'attore ANT sia "bloccato" ed estraneo alla circolazione dell'azione nei network di cui è stato parte. Nel relativo sotto paragrafo si indica come nel concetto di "storicità della cosa" siano contenuti i germi di tale blocco anche relativamente alla teoria stessa, e non solo della teoria come abitante della propria ontologia. È stato inoltre discusso come l'idea di *black box* introduca una trascendenza nell'immanenza latouriana, poiché vincola l'ontologia di alcuni attori (che dovrebbe basarsi unicamente sulle loro relazioni *hic et nunc*) imputando la loro permanenza e "impermanenza" nella medesima forma alla decisione epistemica di "credere" nella verità/utilità/verosimiglianza di tali attori. Sulla scorta di tali osservazioni, sembra farsi strada la necessità di mettere a fuoco un criterio di individuazione degli attori che sia trasversale ai network in cui compaiono, e tale da giustificarne una certa permanenza nella medesima forma. Data l'ontologia dell'ANT, può aver senso una richiesta simile? Sì, a patto che tale permanenza sia causata da una qualche azione tracciabile.

Nel quarto paragrafo emerge, a partire da uno studio della circolazione dell'azione internamente all'ANT, come il concetto di "catene di traduzione" (e quello ad esse connesso di "mobile immutabile") non sia adeguato ad assolvere il compito d'individuazione "trans-network" per attori "bloccati" come l'ANT stessa; per tale "blocco" viene proposta una possibile spiegazione. Emerge, inoltre, come l'idea stessa di mobile immutabile implichi un'internalità alla metafisica latouriana che vanifica la speranza di aver trasformato la sociologia in una disciplina globalmente relativistica. Forse, sarà di consolazione a Latour il fatto che nemmeno la fisica è globalmente relativistica, nella misura in cui esistono tutt'ora alcuni suoi ambiti non coordinati (non coordinabili?) con la relatività einsteiniana come le teorie di campo quantistiche (per esempio, l'elettrodinamica quantistica e la Quantum Chromodynamics). Al contrario, l'intertraducibilità tra punti di vista differenti è salvaguardata internamente all'ANT, o quantomeno all'interno della sua metafisica.

In una filosofia immanente e relazionale, il mutare degli attori all'occasione di nuove relazioni è la norma; in questo senso l'ANT come attore-teoria contraddice se stessa come teoria-attore, prestando il fianco alla conseguenza paventata da David Bloor nell'enunciazione del principio di riflessività. D'altro canto, in qualsiasi teoria le anomalie vengono tipicamente ignorate fino a quando non è più possibile sottostimarle. Il fatto che l'ANT rappresenti un'anomalia ai suoi stessi occhi è forse da interpretare come il raggiungimento di questo limite: non è più possibile ignorare l'anomalia. In questa direzione si colloca la rilevata necessità di un principio d'individuazione trasversale ai network. L'ipotesi che si avanza consiste nell'affermare l'esistenza di un tipo di azione finora sfuggito ai nostri occhi, la stessa individuata nel paragrafo 4 come causa del blocco cui è sottoposta l'ANT. Definiti gli attori/attanti come nodi/snodi d'azione, risulta conforme alla teoria ricercare la ratio di tale principio in una specifica azione, e dall'analisi svolta pare che tale azione abbia un corso ricorsivo, ovvero parte dall'ANT per ritornare ad essa. Considerando quest'ultima alla stregua di un attore della propria ontologia, l'azione ricorsiva risulta essere interna ai differenti livelli della teoria.

Dalle considerazioni svolte in merito alla traducibilità e tracciabilità del riferimento, risulta anche chiaro come sia necessaria una certa internalità alla metafisica latouriana perché si possa considerare ogni attore parte dell'ontologia designata da quest'ultima. In questo preciso senso, l'azione formattatrice che si sprigiona dall'ANT è caratterizzata da una spiccata resistenza che si oppone all'azione formattatrice esercitata dagli altri attori su di essa (infatti, è risultata inamovibile nella forma a prescindere dai network in cui si è inserita). In questo senso, l'ipotesi qui proposta è quella dell'esistenza di alcune azioni, e quindi di alcuni attori, dotate di un potere di formattazione relativo (ai differenti network) superiore ad altre, tanto da resistere all'azione formattatrice esercitata da ciascun altro attore su di essa, rivelando in tal modo la particolare direzionalità ricorsiva dell'azione. Una tale ipotesi non può che essere testata empiricamente

nell'immanenza di specifici network, come qui è stato fatto per l'attore ANT. In questo senso, non si può che rimandare a future ricerche antropologiche.

Se il "blocco" individuato può essere spiegato con la scoperta di un'azione finora sfuggita allo sguardo, lo stesso non può dirsi in merito al "lasciar fare" e al concetto di descrizione, che non solo contraddicono quanto l'ANT afferma teoreticamente, ma rischiano di minarne il valore screditando la funzione delle inscrizioni e delle possibili traduzioni. Alla luce di quanto emerso in queste pagine, mi auguro che la catalogazione delle possibili modalità epistemiche degli attori non soppianti come direzione della ricerca negli STS un approfondimento dello studio delle tipologie d'azione coinvolte nella determinazione ontologica degli attori. Spero che il presente lavoro possa intendersi come un passo in tale direzione.

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Of Sensors and Sensitivities

Towards a *Cosmopolitics* of "Smart Cities"?

Martin Tironi
Pontificia Universidad Católica de Chile

Tomás Sánchez Criado
Open University of Catalonia

Abstract This essay reviews diverse strands of empirical and theoretical work in different urban studies areas (urban planning, urban ethnography, urban geography, and STS) reflecting on the manifold ways in which the *smart city* project is being "opened up" for scrutiny through experimental projects developing digitally-mediated sensing practices of either a specific or broad kind: i.e., producing both devices formally devised for sensing specific parameters, and sensing devices –emerging from less specific digital technology arrangements– used to share experiences, show solutions or politicize different urban issues. In doing this, we seek to understand, from an STS standpoint, the different ways in which a broad range of works are analysing the development, intervention, maintenance, and opposition of these ideas. In the first section we focus on understanding the definitions, features and clashes that several of these corporate projects (mostly municipal in nature) have come across, deploying smart devices, such as sensors to produce an "algorithmic city". In the second section we expand the meanings of "smartness," focusing on grassroots appropriations of broader digital arrangements and politicizations of open source infrastructures to display other forms of urban sensitivities, contributing to the *cosmopoliticization* of the "smart city" project.

Keywords: Smart city; cosmopolitics; sensors; experiment; sensitivities.

Corresponding author: Martin Tironi, Pontificia Universidad Católica de Chile, School of Design. Los Navegantes 1919, Providencia. Santiago de Chile – E-mail: martin.tironi@uc.cl.

1. Introduction: Opening up "smart cities"

The "smart city" has recently become a fashionable yet broad concept in urban design (Picon 2014). It designates those cities that are governed through the pervasive use of manifold digital devices, and most notably sensors, with the aim of providing more accurate data intelligence for better decision-making.

This paper reviews and discusses, from an STS standpoint, diverse strands of empirical and theoretical work in different urban studies areas (urban planning, urban ethnography, urban geography, and STS) that reflect on some of the ways in which the smart city is being "opened up" for scrutiny through manifold experimental projects, developing digitally-mediated sensing practices of either a specific or broad kind (i.e. both devices formally devised for sensing specific parameters, and sensing devices emerging from less specific digital technology arrangements to share experiences, show solutions or politicize different urban issues). In doing this, we seek to understand the different ways in which a broad range of recent works are analysing the development, intervention, maintenance, and opposition of these ideas; but also countering the disembodied versions of *smart city* projects through the deployment of the manifold ontological politics of its "urban assemblages" (Farías 2011).

In line with these prospects, the first section discusses literature analysing the experimental deployment of so-called *smart city* devices (Marres 2012; Karvonen and van Heuer 2014; Tironi and Laurent 2015), mainly developed by municipal and corporate consortiums around the world. Indeed, these arrangements require of manifold experts and citizens to either become avid interpreters of sensors' data or to engage in different forms of urban automated sensing (Gabrys 2007) on a huge variety of issues, ranging from air quality and urban hygiene to traffic lights and roads maintenance, mobility and public transportation, urban accessibility or remote care for older and disabled people. Thus, many of these initiatives might be contributing to the articulation of different forms of *cyborg citizens* (Gandy 2005) or *citizens as sensors* (Goodchild 2007).

The second section explores the "cosmopoliticization" of smartness, addressing a number of experiments in slowing down the *smart city* project. On one hand are top-down institutional and industry-led projects, seeking to govern entire urban ecosystems with the participation of the public – be it as providers of data or taking part in their interpretation and classification. On the other hand, individuals and communities are also crafting and using digital technologies, from very sophisticated sensors to over-the-counter smartphones and social media. These individuals and communities are increasingly organizing into different forms of *do-it-yourself* grassroots collectives, seeking to "open up" the city through different forms of urban sensing devices, hence forging different breeds of *expert amateurs* (Kuznetsov and Paulos 2010). For some of these diverse and not always coordinated collectives of amateurs, this "opening" means having the chance to share ideas and knowledge on how to build and experiment with sensing technologies with a more or less fixed institutional framework. For other activists or advocacy-led projects, permeated by a more radical *hacker ethos,* opening sensing devices means making available other sorts of experiences and urban sensitivities, as well as explicitly countering top-down versions of the smart city through the articulation of open-source infrastructures that redistribute *smartness*.

2. Experimenting with the urban: The practices and discourses of smart cities

There has been growing consensus in recent years that the advances in Information and Communication Technologies (ICT) are transforming the urban experience, redefining many of the usual presuppositions in the analysis and management of cities. The analysis of the role that different technologies have played in the design and government of the city is far from new in STS[1]. What seems to be contemporary relevant to analyse is the usher dynamism and the great investment in a gigantic and transnational "market of experimentations", leading to the craft of all sorts of digital technologies for the management, organization or regulation of urban space.

Many of these transformations and its associated discourses and hopes are usually captured by the term *smart city*. Indeed, the *smart city* concept has materialized into specific urban technology projects, having an undeniable impact: transforming many urban spaces into vast and privileged scenarios to experiment with multiple computational interventions and strategies. In fact, it has become a catchy category that has managed to jump into many urban discourses and practices, an aspirational benchmark for cities all around the world (Campbell 2012; Greenfield 2013; Picon 2014; Sheltona et al. 2015). Thus, in line with this trend, several capital cities are nowadays in a feverish process of developing *smart* solutions, attempting to make the principles of the techno-smart or digital city tangible and operative (Greenfield 2013; Picon 2014).

Beneath the surface of the different experiences in smart urbanism through an extensive application of new ICT, cities are allegedly able to transform themselves into "more intelligent and efficient" places, "improving the quality of life" for their inhabitants (Campbell 2012). This techno-intelligent paradigm is gaining particular momentum in light of the exponential growth of urban zones in the planet (UN 2008), with its concomitant effects: an increasing public demand for services and growing difficulties faced by local governments in responding appropriately to this surge in demand (Harrison and Donnelly 2011; Yesner 2013). In fact, this context is tightly associated to the creation of a new technology market boosted by industries and companies (e.g. AT&T, IBM, CISCO, Huawei, Telefonica, Siemens, etc.) that see in the expansion of this discourse possibilities for the development of new and specific services for municipalities in a moment of great economic contraction.

[1] Classic STS references include the works of Callon (1980) on the controversies surrounding the electric vehicle project; Hughes (1983) on the electrification of urban zones; and Winner (1985) on the political effects of infrastructures, together with the seminal work by Latour and Hermant (1998) on Paris' infrastructures.

Building on more recent research in STS, combining aspects of urban planning and Actor-Network Theory, that has explored the sociomaterial aspects of urban infrastructures (Aibar and Bijker 1997; Coutard et al. 2005) in this paper we would like to analyse how those "smart" infrastructures might be enacting an ontologically multiple space of "urban assemblages" (Farias and Bender 2009; Farías 2011). To our mind, the "urban assemblage" perspective is especially of interest to address these contemporary ICT-driven transformations affecting the urban fabric – such as those digital technologies seeking to build augmented environments and connected atmospheres–, and how they enact manifold articulations of the urban as well as diverse definitions of its users, going beyond socio-constructionist and critical discourses of the contemporary forms of the urban that address these transformations as the mere materialization or transposition of ideas, discourses or ideologies into the built environment[2].

What sorts of recompositions and redefinitions are being introduced by this "intelligent city" paradigm? And consequently, what are the empirical and theoretical challenges that this scenario poses to urban-minded STS? Building from this, in this section, we will outline some of the issues which, in our opinion, are presented by the practices and discourses of smart cities, associated with a profoundly experimental understanding of the city and the urban experience.

2.1. Normative variations around a concept

The high level of visibility that the *smart city* concept has garnered (in international fairs, rankings, corporate white papers, public administrations' grey literature, etc.) has been accompanied by a prolific and varied output of academic papers, books and TED-like talks on the subject. In general, such literature can be classified into two broad categories:

(1) Works that focus on the great transformations and urban reconfigurations that come to be associated with this concept, be it in terms of how it entails economic advantages for the city, pushing for the social innovation of smart infrastructures, or stressing the increasing importance of users' experiences and their new role as "sensors" and codifiers of information (Mitchell 1995; Florida 2003; Campbell 2012; Harrison and Donnelly 2011; Caragliu et al. 2011; Yesner 2013). These perspectives, glorifying smart artefacts, not only highlight the features of auto-programmable infrastructure networks (roads, bus stops, maps, waste disposal, heating, tourism, banks, restrooms, signage, shops, energy, street lighting, cycle lanes, etc.) but also the role of the "creative class" (Florida 2003) in producing flows of information. One of the key con-

[2] For example, Graham and Marvin postulate that modern urban infrastructures are more and more closely linked with "neoliberal" political criteria relating to the way the city is governed and managed (Graham and Marvin 2001, 96).

cepts is that of "sentient cities" or "senseable cities" (Shepard 2011). This concept refers to the capacity of cities to record and digitally-encode their "sensations" and states (e.g. weather, air pollution, traffic, energy consumption, etc.) thanks to thousands of smartphone users – smart sensors distributed among people and infrastructures able to manage large data sets and flows of information about both human and non-human life in the city.

(2) Works that criticize this triumphalist version of the smart city. These works are usually sceptical about the extent of the alleged claims that ubiquitous and intelligent city projects might be fostering greater "urbanity", "democratization" and "inclusion" (Gabrys 2014; March and Ribera-Fumaz 2014; Powell 2014). Many of them analyse the asymmetries (of information, control, transformation, etc.) generated between users and large telecommunication companies (Greenfield 2013; Viitanen and Kingston 2013; Kitchin 2014), the omnipresence of these companies in fabricating and managing the city (Galdón-Clavell 2013; Vanolo 2013; Sennett 2012), the role of the narrative strategies used by multinationals to become an "obligatory passage point" (Söderström et al. 2014). One of the most acerbic and well-known critics of the *smart city* idea, Evgeny Morozov (2014), even maintains that the promises of smart urbanism are based on "technological reductionism" and "neoliberal short-termism", in which all of the city's ills appear to be resolved privately (via smartphone apps) which, so he states, lead to processes of disconnection and de-politicization.

2.2. Design and experimentation with "intelligent" futures

One aspect seldom discussed in both strands of literature is the "experimental" or, rather, speculative nature of the socio-technical assemblages that constitute the *smart city* constellation of projects. The relationships between the entities that feed this paradigm –their layout and devices, concepts and designs, services and actors, markets and cities– are far from being a finished product. In this respect, adopting a Foucauldian approach, Gabrys suggests that "[…] smart-city plans and designs, as proposed and *uncertainly* realized, articulate distinct materialities and spatialities as well as formations of power and governance" (Gabrys 2014, 3). Therefore, although the concept is presented as an "organic model" of urban management, its *modus operandi* is way more related to forms of urban prototyping and speculative design.

It is no coincidence that the principal development strategy of *smart city* projects consists of pilot studies, allowing large companies to test technological and service prototypes, carrying out different forms of "urban laboratories" to test and demonstrate the durability and "social" integration of their products and services (Tironi and Laurent 2015). Be-

yond what usually happens in Living Labs[3], it could be said that in many of these *smart city* projects the city itself is used as a testing ground, crafting other forms of urban experimentation. That is, *in vivo* interventions expanding the frontiers of the urban laboratory towards the city itself, multiplying the uncertainty and the possible overflows, in order to determine the life or death of smart innovations.

Smart city projects, hence, are part of very specific corporate-led "speculative design" investments (in the sense developed by Dunne and Raby 2013), creating grand scenarios outweighing the need of being actually carried out and implemented in full. Those grand speculative scenarios acting out potential urban futures – most of them grounded in the idea that an extensive management of technological intelligence will solve the cities' problems – are rather developed to experiment with different technological solutions. Indeed, very often the actual ability of the developed artefacts to calculate and capture different urban activities (from a person's caloric consumption to the levels of carbon dioxide present in the streets) is not very accurate, opening up multiple spaces for further experimentation on such devices[4]. Therefore, in *smart city* projects, the future becomes an experimental category used to mobilize resources and interventions, to manage uncertainties and expectations (Bublex and During 2014)

This means that, despite the heavy corporate investment in promoting the concept, *smart city* business models and applications usually reveal far more uncertainties than certainties, its technological devices being more *speculative* and *exploratory* than decisive or definitive in character. In other words, in many of these projects *intelligent cities* exist on a virtual level of "emergences" (Thrift 2014) or "latencies" (Latour 2005), meaning they have not yet achieved a well-defined level of solidification and stabilization as a closed sociotechnical system. The durability of smart action plans depends, to a large extent, on the results of tests carried out on "laboratory" cities or neighbourhoods, citizens and environments, policies and infrastructures (Karvonen and Heur 2014; Tironi and Laurent 2015).

[3] *Living Lab* approaches to innovation design were developed in the beginning of the 2000s (originally attributed to W. Mitchell, from MIT's Medialab). They could be summarized as user-driven forms of co-creation of corporate services and products. Their methods usually entail the modelling of real-life environments in a closed space of experimentation (e.g. the home), deploying manifold interactive technologies to record different parameters (Mulder 2012). These approaches have been crucial for the development of contemporary "ambient assisted living" (AAL) care solutions or sustainable home environments.

[4] For instance, the ontological disputes over the accuracy and the meanings and possible interpretations of algorithmic data on one's health have been haunting the development of sensor-based personal and ambient-assisted living care technologies (see Soler and Trompette 2010 for an interesting ethnographic study on the disputes between health professionals, engineers and users in a sensor-based "epilepsy crisis detection" pilot project).

The speculative mode of smart city experimental strategies can then appear as a way of granting *degrees of reality* to white papers and narratives, protocols and socio-technical artefacts, individuals and collective actors. Drawing on Latour's latest work, we can say that smart urbanism has a "mode of existence" based on testing in situations of ontological uncertainties (Latour 2012)[5]. It is precisely this "experimental mode of existence" of the *smart city* concept that we aim to problematize in this paper.

2.3. Designing algorithmic cities

One of the main presuppositions of *intelligent* urbanism is that every event or actor (human or non-human) has the potential to generate some type of perceptible pattern, metric or information. Thus, Benjamin's "flâneur" city, together with its oblivious and creative experiences, might vanish in the face of an ongoing process in which "cities are [treated as] becoming 24 hours operations", where everything is available, predictable and prone to manipulation (Thrift 2014). Different sorts of algorithms, processing the ongoing data generated by a wide gamut of specific sensors, are the tools enabling this availability/calculability operation within urban spaces, transforming cities into mass producers of "big data", allegedly allowing for the calculation of patterns and forecasts in real time: data on consumers' spending preferences and waiting times, on the availability of parking and electrical distribution, on traffic congestion and weather conditions, etc.

While the capacity of "algorithmic urbanism" to predict and anticipate has a clearly speculative dimension, there is no certainty as to the type of "intelligence" that can be attributed to this sea of information in terms of how and who might process it. As indicated by Gillespie (2014), the relevance of algorithms (the content, form and hierarchy of information) is never neutral. On the contrary, the urban experiences out of which these algorithms operate are codified and assembled by framing them through a particular range of political notions, nomenclatures and visualization metrics. The invisibility with which these technologies operate (their design, patterns, negotiations, and maintenance) may give its users the sensation of navigating and interacting with these interfaces in a transparent manner, determined only by criteria of "algorithmic objectivity". As Gillespie indicates, "algorithms are a powerful invitation to understand ourselves through the independent lens they promise to provide" (2014, 186-187).

We might talk about an interest in producing the smart city as a form of "algorithmic urbanism", because in many of these projects data-

[5] As various works in STS have shown (Pinch 1993; Shapin and Schaffer 1985; Marres 2012; Tironi and Laurent 2015) experimentation not only acts as a means of testing, it also manufactures and fabricates realities. Prior to such experimental testing, the cognitive and material entities that make up the world are unknown.

processing technologies are increasingly required to become the omnipresent strategies to engage with the city. However, this scenario raises questions regarding (a) the types of experiences taken into account by these intelligent algorithms translating the city into digital interfaces; and (b) the degrees of intervention available to users to feel, practice and participate in the construction of the city. It is therefore necessary to question the "interface politics" of these algorithms, examining their form and content and the ways in which information about the city is modelled, simulated and made visible. If we consider the interfaces as *oligoptica* (cf. Latour and Hermant 1998), i.e. as situated devices-emplacements where information about the world is framed, interpreted, condensed and miniaturized, we might also question the way in which the urban experience is encapsulated and standardized (Mattern 2014) in these accounts.

2.4. Configuring more affective cities?

With the expansion of smart sensors and algorithms, the capacity of contemporary cities to *feel* has also become the focus of analysis (Thrift 2014). In the smart cities project, the emotional dimension is no longer considered an exclusive attribute of human beings; it is an element that has become integrated into the distributed computational nomenclatures (Sadin 2013). Through a heterogeneous collection of sensing technologies, the city might become for these authors an animated and organic agent, "able" – like humans – to emit, monitor and manage its different states. Within smart urbanism, or so it is argued, the responsibility for feeling or being affected is not a human property, and sensoriality becomes a distributed action, equipped and measured by multiple sensors and interfaces.

Indeed, Thrift (2014) states that the most innovative feature of the so called sentient and smart city is not so much the permanent processing and sending of information, but its unusual ability to propagate sentient beings by developing forms of awareness of the urban ecology. It is this capacity to be aware of the things, events and situations that occur, that enables Thrift to make a link between the sentient city and Latour's "parliament of things', in terms of the capacity of non-human entities to exercise forms of agency, to feel and be affected.

In addition to showing how many of these projects incorporate and mobilize more plural, and sometimes unknown, non-human agents through responsive and algorithmic strategies, we should be careful in using such a parliamentary metaphor, and address the particular materializations of politics in *smart city* projects. In fact, analysing the role attributed to citizens' participation in such projects, Gabrys (2014) shows how individuals in these projects might be considered as *sensing* citizens, sensitive nodes who through their interconnections with computational environments are constantly being fed data back, but:

> The actions of citizens have less to do with individuals exercising rights and responsibilities, and more to do with operationalizing the cybernetic functions of the smart city. Participation involves computational responsiveness and is coextensive with actions of monitoring and managing one's relations to environments, rather than advancing democratic engagement through dialogue and debate. (Gabrys 2014, 9).

Gabrys (2014) uses the notion of "biopolitics 2.0" to refer to the capacity of intelligent cities not only to determine intimate aspects of people's daily lives, but also to redesign and reprogram environments and citizens' behaviours from calculated patterns of data captured through these sensor technologies. Another interesting term for this might be "soft biopolitics", as employed by Cheney-Lippold (2011) in his studies of algorithmic identity construction by social media retailers such as Amazon. Schüll's (2012) ethnographic study on the algorithmic design of Las Vegas casino environments, and her most recent work on the Quantified Self community, using commoditized sensor-based devices or "wearables" to track different aspects of their everyday life and "prod oneself to take action" (Singer 2015) being interesting epitomes of these "soft" or 2.0 forms of biopolitics to reflect on.

Building from here, many critics point out that such corporate-driven arrangements might be forging a "post-political" urban design scenario, and hence urge "[…] to repoliticise the Smart City debate" (March and Ribera-Fumaz 2014, 12).

3. Cosmopoliticizing *smartness*, or experiments in slowing down the smart city?

To address that purpose, in this second section, we further analyse the *smart city* idea by focusing on other works that might help us expand the meanings of what sensing and urban *smartness* might mean. Here, we would like to review literature addressing digitally-mediated sensing practices developed in grassroots projects that have emerged alongside, but also intersecting and opposing, *smart city* projects. These initiatives have as their main goals the democratization of the cities' infrastructures – both digital and non-digital – and the politicization of several aspects of urban matter (Barry, 2013).

Indeed, in the past decades our urban arenas have seen the emergence of many online and digital collaborative platforms (Aurigi and De Cindio 2008; Fish et al. 2011; Juris 2005; Turner 2006) whereby people devote to jointly creating, maintaining and sharing all kinds of data allowing them to constitute into communities of sorts, producing many types of urban events, and taking part in manifold urban sensing activities such as, for instance, "collaborative mapping" (Furtado et al. 2012) of certain areas to

generate relevant visualizations for political action (see, for instance, Denis and Pontille (2013) on the efforts by OpenStreetMap activists to create and maintain maps where cycling ways are explicitly shown).

What if these grassroots appropriations and politicizations of digital infrastructures might be helping us to display other forms of sensing urban sensitivities? What if these so-called alternative projects might be contributing to the *cosmopoliticization*, to use Isabelle Stengers' (2005) terms, of the "smart city" project? Indeed, "alternative" projects may provide concerned parties with instruments to slow down, avoid the pitfalls of either praise or criticism, and learn how to build more interesting relations to what the ongoing digitalization of the urban might bring (DiSalvo 2012; Ratto et al. 2014). They could also help, in the process, to account for the manifold actors and entities that could have something interesting to say about such intricate urban digital assemblages.

3.1. Crafting alternative digital arrangements to sense neglected urban sensitivities?

"In what ways do distributed sensor technologies contribute to new sensory processes by shifting the relations, entities, occasions, and interpretive registers of sensing?", asks Gabrys (2012). We believe that, beyond the highly formatted and algorithmic-centric sensing experiences deployed by the *smart city* projects analysed in the previous section, other forms of ICT-based assemblages might have also formed in recent times, prolonging richer and more intricate forms of sensing urban experiences (cf. Ingold and Vergunst 2008; Pink 2008), with a long tradition in the social sciences[6].

The current intensive use of digital devices – from over the counter devices, such as personal blogs, social networks, mapping apps; to other more elaborate yet cheap DIY sensors (Newitz 2015) – by many activists and advocates is in many cases signalling a true "media rebellion" (Chateauraynaud 2013). The *Indignados* and Occupy movements are a recent epitome of this trend, as explored by Corsín and Estalella (2013), Lenzner (2014), and Postill (2013). This allows for the more collaborative and sometimes non-structured identification, reflection and vindication of neglected urban issues (Chateauraynaud and Debaz 2013). Thus, they bring into existence more complicated forms of digital urban "sensing", expanding the register of experiences beyond what appears in many municipal and corporate-led smart city projects.

Chateauraynaud and Debaz (2013), for instance, examine different examples of environmental health activists using digital sensors to make perceptible what might be affecting people sensitive to different things.

[6] See Highmore (2002) and Wark (2011) for interesting accounts on the surrealist and Situationist movements, as well as on the work of "everyday life" theorists, such as Lefebvre or De Certeau.

For example, atmospheric toxic chemicals in the city (Calvillo 2014) or ever-expanding electromagnetic radiation camps such as the ones produced by ICTs – the very same ICTs the smart city project deems interesting to build more efficient and inclusive cities (Chateauraynaud and Debaz 2010). Hence, through the use of such digitally-mediated sensing practices, their otherwise unruly and uncertain bodily sensations are "remediated" (cf. Bolter and Grusin 2000) creating space for the "articulation of the bodily differences" (Latour 2004). This is not only to systematically share all sorts of data on one's experiences and produce new information about a particular condition, but also to produce and share relevant knowledge on how to tackle those situations (Akrich 2010; Brown et al. 2004; Goodings and Tucker 2013; Tucker and Goodings 2014).

By creating different forms of sensors, these collectives "[…] would not allow to be defined by the metrological space held together by exterior instances and take charge of the laboratory in the open" (Chateauraynaud and Debaz 2013; our translation), producing a relevant intervention in the "regimes of perceptibility" that is, in the "[…] sedimented contours of perception and imperception produced within a disciplinary or epistemological tradition" (Murphy 2006, 24) emplaced in our urban arenas. Those regimes of perceptibility "[…] populate our world with some objects and not others, and they allow certain actions to be performed on those objects" (Murphy 2006, 24). In fact, many of such practices might be thought of as digital vernacular forms of "street science" or other analogous activist interventions in knowledge, techno-economic and legal expertise, *reclaiming the production of knowledge about the city and its inhabitants* (Brown 1992; Corburn 2005; Parthasarathy 2010; Rabeharisoa, Moreira and Akrich 2014). That is, such practices are about producing forms of "sensible politics" (cf. McLagan and McKee 2012) crafting digitally-mediated platforms, allowing them to create and redistribute not only sensing repertoires but also the relevant expertise needed to produce and inhabit such urban spaces.

For instance, in analysing the experience of Multiple Chemical Sensitivity (MCS) online communities, as sites of environmental health activism on urban matters, Murphy stated:

> […] In cyberspace MCSers found support groups, homepages, and "do-it-yourself" popular culture; people shared information on how to make their own personal ecologies, where to find a "safe" home, do-it-yourself treatments, and therapies that worked for them and might work for others. They offered each other advice and warnings about navigating the workers' compensation machine and other institutional apparatuses, as well as prayers for sustaining the spirit. The Internet [online fora and chats] was a vital site where MCSers communicated how to grapple with the everyday, a space facilitated by an ethic of information exchange (Murphy 2006, 168).

In a way, we could say that such experience-based forms of remediat-

ed sensing practices bring to the fore neglected sensitivities, making space for alternative experiments to the *smart city* projects delineated above, opening up and expanding the register of urban *smartness* to "more sensitive" contours.

3.2. Experimenting with DIY infrastructures, or the redistribution of *smartness*?

On a different register and to conclude, the *smart city* project might also be juxtaposed to a very particular set of works engaging in the description and politicization of urban infrastructure (Graham and Marvin 2001; Graham and McFarlane 2015; Mongili and Pellegrino 2014). This interest for infrastructure, developed mostly in STS and drawing from the work of Susan L. Star, seeks to foreground "[…] the truly back-stage elements of work practice, the boring embedded things, and, of course, infrastructure" by recurring to narrative strategies producing "infrastructural inversions" (Lampland and Star 2009, 17). Indeed, the most part of citizens living in urban environments affected by smart developments,

> […] relate to infrastructural processes as unproblematic "matters of fact'. That is, for them, infrastructures like energy or water supplies exist ordinarily as take-for-granted resources that can be easily called upon by the simple flip of a switch or by opening a tap. The complex networks of technologies, experts and political actors lying behind those mundane actions are rarely spared a thought. They exist as part of largely invisible "subpolitical" worlds organized and managed by different forms of expert knowledge operating largely outside public debate and accountability" (Domínguez Rubio and Fogué 2013, 1045).

For Domínguez Rubio and Fogué, "[…] the transformation of the subpolitical worlds of infrastructures and nature into fully public and political worlds not only offers a new understanding of urban space but also the possibility of new forms of civic participation and engagement" (2013, 1039). In recent times, an interesting source of politicizations and infrastructural inversions of the urban infrastructures has been the development and great expansion of DIY and experimental urban projects forged by different breeds of what might be called *expert amateurs* (Kuznetsov and Paulos 2010): for instance, engaged communities importing FLOSS[7] concepts –such as the use of free forms of licencing and patenting or the construction of collaborative peer-to-peer (p2p) horizontal governance networks (Musiani 2013) – and a *hacker ethos* (Coleman and Golub 2008) for the purposes of technological (Powell 2012) and urban intervention (Corsín 2014a; 2014b). Many of these collectives and communities –working in new digital workshops, such as FabLabs and other

[7] Free Libre and Open Source Software.

forms of shared machine shops (Dickel et al. 2014; Walter-Herrmann and Büching 2013)–, are engaged in intricate practices of documenting and freely sharing their urban prototypes for collective scrutiny and betterment (Corsín, 2014b; Corsín et al. 2014), constituting forms of "epistemic ecologies in beta" as Corsín calls them[8]. That is, forms of "experimental collaboration" (Estalella and Sánchez Criado 2015) in the production and open-sourcing of urban space.

Open-sourcing could here be taken as an experimental opening of the very matter of urban design for scrutiny and intervention. Indeed, this emerging constellation of projects *in beta*[9] might be entailing an expansion of experimental cultures to urban arenas beyond "the lab" (Gross and Krohn 2005) or "in vivo" forms of controlled experimentation (Callon et al. 2001), so dear to *smart city* initiatives. Thus, such projects *in beta* would be: (a) redistributing who can speculate and open up new questions on how urban spaces should be designed (cf. DiSalvo 2012; Dickel et al. 2014; Michael 2012); and (b) prolonging the political and epistemic reflections on the *right to the city* (Mitchell 2003) in urban studies to other, more experimental, re-thinking of how to democratize the urban. As a result, they might be collectively crafting what Corsín terms a "right to infrastructure," i.e., a right to openly engage in the production and transformation of such infrastructural aspects of the city, which:

> […] gathers materials, devices, appliances, media systems, interfaces, and social relations in a dance of graphematic concatenations. It is a right incarnated in and deployed through very specific (open source) sociotechnical designs, interventions, and affordances. These various capacities make their appearance in an urban ecology as prototypes, whose work tends to destabilize epistemic formations because of their sourcing and enabling of new compossibilities. As I suggested earlier, we may think of the prototype as a sort of "infrastructural being": a fluctuating betagram of persons and things whose holding processes "in suspension" lends political, administrative, and legal ritual different rhythms and capacities" (Corsín 2014b, 358).

In sum, many collaborative forms of DIY experimentation through the articulation of open-source infrastructures might very well be expanding or opening up what we might mean by *smartness*: not only allowing for the generation of other forms of data but also collaboratively redistributing "intelligence" amongst usually neglected agencies, allowing more people to engage in processes of urban *infrastructuring*.

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[8] See http://www.prototyping.es/uncategorized/epistemic-ecologies-in-beta-anthropolog-beyond-open-access

[9] See for instance Wylie et al. (2013) on DIY environmental hazard sensors or Sánchez Criado et al. (in press) on open technical aids produced by independent-living advocates to sense and protest the inaccessible city.

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The Rise of the Insect Industry
Sustainable Potential or Wasteful Accumulation

Roberta Buiani
University of York &
The Fields Institute for Research in Mathematical Sciences, Toronto

Abstract In this paper I explore the relationship between insects, technoscience and sustainability culture made possible by recent developments in fabrication, micro-robotics, and design. I define the resulting scenario as "Insect Industry". This emerging agglomerate of practices and technological developments is comprised of practices and applications that promote, exploit and manipulate insects for their sustainable potentials. Among these practices is the flourishing of visionary micro-farming enclosures and experimental food-design, contributing to the urge to produce sustainable sources of food; the re-making of insects in micro-robotics; and the design of GM insects to help fight devastating diseases such as Dengue Fever. Although engaging with distinct fields of research and forms of creative entrepreneurship, these endeavors use very similar strategies and discursive patterns to promote innovation and sustainability, and the promise to fix the world. In illustrating a variety of examples in microrobotics, fabrication, and bioengineering, I ask: is this recent trend really marking the beginning of a new phase in sustainable innovation based on Humans/animals balanced coexistence or it rather constitutes another (maybe more acceptable or more palatable) form of exploitation of the non-human? Is this newly emerging "insect industry" obeying or rather contradicting the imperatives of economic growth and the principles of technological innovation supported by Western Culture?

Keywords: sustainable innovation; interspecies relation; anthropocentrism; biomimicry; solutionism.

Corresponding author: Roberta Buiani, The Fields Institute for Research in Mathematical Sciences, 222 College Street – Toronto, Ontario, M5T 3J1 – Canada – Email: robb@yorku.ca.

1. Introduction

In "Meeting the Universe Halfway", Karen Barad describes the brittlestar's remarkable nature as a "living, breathing, metamorphosing optical system" (Barad 2007, 370). The brittlestar has no brain, but behaves as if it had one; it has no eyes, yet its entire body is a constellation of tiny

eyes. This discovery has potentials to shake our traditional Cartesian constraints that prevent us from associating mind and performed entanglement of physical matter, and that force us to distinguish between intentionality and casual, unconscious agency. However, scientists preferred to interpret this phenomenon as "unusual" (Abraham 2001), and proceeded to describe this configuration using technological analogies and metaphors, a register that could reproduce the significance of this surprising discovery in a way that is easy-to-grasp and that could be unambiguously disseminated.

This example reveals the – inadvertent or voluntary – inability to think beyond preconceived ideas of the individual as self-contained (as opposed to the networked being manifested by the brittlestar's appearance and behavior), as unique (contrary to the brittlestar's multiplicity) and as sentient (contradicted by the brittlestar's apparent decision-making abilities even without the existence of a brain). How could it be otherwise possible to think of being (eyes) and doing (seeing) as one thing?

According to Barad, the excitement that followed the reporting of this story "has more to do with its potential applications than pure amazement at the ingenuity of this creature's bodily know-how" (Barad 2007, 373), as the brittlestar is compared to a digital camera that builds its vision pixel-by-pixel. Thus, it is not through a rethinking of the humanist episteme that scientists and observers have attempted to make sense of this bizarre creature, but through technological associations. On the one hand these technological analogies simplify and reify the complexity of the brittlestar and align it to traditional interpretations of the natural. On the other hand, they reveal an instrumental and anthropocentric approach that seems to be more devoted to the use of biomimetics to solve human questions (e.g., the construction of better optic devices and material design) than to the understanding of the new.

In other words, this line of thinking refuses to abandon the idea of human exceptionalism (Wolfe 2013), the position that human beings are the most important species in the planet, and the refusal to admit that the identity of the human species "is not unified or self-present, but thoroughly implicated in the phenomenology and ontology of other nonhuman species" (Chiew 2014, 54).

The insect industry is clearly a product of the resistance and the incapacity to think beyond human exceptionality. However, it does so indirectly, through the refusal to question (or the opportunist complacency with) the economic and technological systems upon which this human exceptionalism is based.

In the next pages, I zoom in on the specific nexus of sustainability culture and emerging technologies in the cooptation of insects. In particular, I propose examples based on a variety of technological innovations, whose analogous use of rhetoric and discursive approaches suggests that they be analyzed as part of the same trend. I define this trend "the insect industry".

Despite their different uses of technologies, these examples actively participate in the mechanisms of capitalist values of production and consumption, showing how the cooptation of insects in their endeavors hinders, rather than propose, any meaningful transformation to the current industrial/technological principles of growth. The very attachment of the insect industry to these principles – and its consequent reliance on technologies for its survival – proves to be a popular, yet momentous trend that might do nothing to solve the problems it has claimed to tackle. As ultimate result, despite its alleged forward-thinking, the insect industry is stuck with the good-old model of human exceptionalism.

2. Technology and the Living

The analogy between technology and the living brought us "a particular production of nature", as a condition of the "Postmodern World", whereby "Technological decontextualization is ordinary experience for hundreds of millions if not billions of human beings, as well as other organisms" (Haraway 1992, 297). In her Cyborg Manifesto, Haraway identifies this particular production in terms of "implosion of biologics and informatics", that is, as a way "of conceiving of us as communication systems, whether we are animate or inanimate, whether we are humans or animals... or machines of any kind" (Haraway 1989, 322). In a way, the description of the qualities of the brittlestar noted by Barad demonstrates this line of thinking, as scientists not only immediately compared the creature's eye-ness to tiny web cameras, but also appeared to be unable to tell the two items apart.

The non-human, the animal have been sources of inspiration and the subjects of imitation stemming from the acknowledgment of their abilities to run faster, to blend in and hide, to accomplish certain tasks in ways that humans deemed more "efficient". At the same time, they have been the subjects of (unintended or unrealized) exploitation. In fact, human aspiration to run faster, to fly, to see without being seen, to be more efficient have come with the assumption that these abilities could be one day turned to the service of mankind. Thus, non-human entities and animals were caught in a non-reciprocal relationship that located them, no matter what, on a lower scale.

Analogies and comparisons between mechanical objects and organisms, natural phenomena and engineering constructions have circulated at least since the XVI century, becoming widespread in the XVII century with the Scientific Revolution. As human faculties (e.g. the nervous system or human organs) were compared to the gears of clocks or the parts of mechanical instruments, so these very instruments drew inspiration from natural organisms and phenomena. For example, Leonardo da Vinci famously observed the flight of birds and examined the nature of air in order to build his flying machines, which culminated in the study *Codice*

sul Volo degli Uccelli (*Codex on the Flight of Birds*, 1505-06). Peter Galison reports how for Descartes, Galileo and Bacon, machines-objects analogies had important expository and explanatory roles, providing simple and compelling examples for dissemination among a wider public (Galison 1984). For instance, Descartes described the human nervous system as an engineering apparatus consisting of "water pipes" upon observing the mechanisms that animated the statues and the skilfully engineered fountains located in the royal gardens of Saint-Germain.

The recent rise of animal rights and countless studies in environmental science have suggested that the human and the non-human stand in a symbiotic relationship rather than in a subordinate one. The ontological turn in anthropology started to shift focus from "how humans and their worlds are portrayed" to "how they are thought to be"(Kirksey et al. 2014, 3), partially transforming the way in which we speak about, we relate to, and we use animals and natural resources. Ethnographers for instance no longer only explore human actors, but also interspecies relations, or how "the human has been formed and transformed amid encounters with multiple species of plants, animals, fungi, microbes" (Kirksey et al. 2014, 5).

Historically, insects have inspired the arts and the industrial sector, they have functioned as blueprints of behavioral, technological, and social models (as in the areas of biomimetics and biomimicry), and have been used as metaphors of class and social power, self, and the other (Siganos 1985; Hollingsworth 2005; Magnet 2013).

However, my interest lies in a more specific set of relationalities (or "intensities", to reference Parikka 2010) emerging from their material intersections with technoscience and its inherent discourses. Specifically, I wish to complicate the emphasis that recent texts in Media Studies and Animal Studies have placed on the mutual exchanges (unconscious and instrumental) occurring during human-animal encounters and between animals and technoscience (Haraway 2008; Parikka 2010; Wolfe 2013).

For instance, Donna Haraway conceptualizes the threads interfacing humans with animals (and insects) as a "becoming with," that is, as a "tapestry of shared being/becoming among critters (including humans)" (Haraway 2009, 118). This tapestry includes "unequal and ontologically multiple instrumental relationships", where different "responders are themselves co-constituted" (Haraway 2009, 116).

Cary Wolfe uses this notion to rethink the Posthuman as not being about the way in which "the human is transformed and eclipsed by various technological, informatics, and engineering developments rooted in the early Twentieth Century"(Wolfe, in Serres 2007), but about the processes unfolding through these uneven relations. This relational move, Parikka notes (2010), manifests at the material level as the capacities of human and animal bodies can no longer be detached from considerations of their technological framings. Thus, at least in some contexts, we can see a turn towards considering the non-human insect worth of our partial

respect, yet not before being properly anthropomorphised or made more human.

Although for these authors issues of conservation and sustainability in industrial societies are certainly important in modulating the intersections between the human, insects (or animal), and technologies, they only constitute two of the many aspects converging into such intersections. For Parikka, today's intensification of technoscientific research and innovations centered on insects is the product of a complex entanglement of technology "with a variety of animal bodies and nature" whereby insects have made the "cyborg as imagined since the 1980s in theory and fiction seem quite old-fashioned" (Parikka 2013, 108). However, he admits briefly, in this scenario the human is far from being taken off the picture.

The most recent wave of projects focusing on the intersection of insects and technologies tends to prioritize a new type of instrumental anthropocentrism that aggressively pursues insects through manipulation and re-fabrication in the name of a discourse – sustainability – presented as the pursue of the harmonious coexistence between, and balance of, humans and non-humans, yet still profoundly focused on the human. In fact, in many cases, insects are neither mere conceptual inspirations and technical models, nor organisms explicitly at the service of human goals (like in bee keeping or silkworm husbandry), but entities that have become physically built into these very technologies. In other words, insects become not only the subjects legitimating technologies, but also the entities that technologies will substitute, modify or keep alive in order to guarantee humans' economical wealth and everyday survival. This interpretation frames insects as both in symbiosis with, as well as subjected to technologies, an ambiguous relation reminiscent of the relation between sustainability culture and the capitalist system of values hosting it.

3. Exceptionalism and the Sustainable Paradigm

I ascribe the recent technological and entrepreneurial undertakings forming the insect industry to the dual conception of sustainability culture, which is often described as a "contradictory nexus of relations between production, ideology, state and society" (Parr 2009; see also Goodbun 2010). In fact, today's technological paradigms and the economic obligations of late capitalism play a substantial role in shaping (and clashing with) the sustainable content that these new practices claim to support. For instance, their commitment to ethics of conservation and waste reduction are challenged by practices supporting consumerism and accumulation (Harvey 2005; Sullivan 2013). Although the rhetoric and enthusiasm of these practices praise the potential environmental benefits of new technologies and industrial applications, these benefits are always tied to principles of ceaseless growth and obsolescence (Slade 2007; Burnett et al. 2009).

While applications merging insects and technology seem to acknowledge the coexistence and mutual dependence of insects (as animal/other), technologies, and the human, their mandate and goals are skewed towards the sole improvement of the human species. In other words, although the rhetoric that propels the insect industry seems to agree with recent Posthuman concerns regarding the role and the value of the non-human other for human existence, prompting a call to act quickly in order to preserve the world as we know it, its doing tells another story. In fact, these post-human concerns are generally contradicted by the prioritization of human needs at the expenses of ecological balance. Furthermore, the ambiguous interpretation of the word "sustainable" and "sustainability" appears to legitimize unchecked growth and surplus production, as well as maximization of financial gains.

In the first case, the idea of preservation and the call to responsibility that often characterize the industries and research facilities involved in insect fabrication, breeding and modification, is principally opportunist, preoccupied, to various degrees, and expressed in more or less blunt words, to reach the good of human species, rather than to attain a balance for the entire ecosystems. For instance, the fabrication of robotic insects as substitutes for the biological ones is primarily conceived as a solution to the possible disappearance of crops and goods vital to human healthy living. Normally, these endeavours make no provisions regarding the overall impact that the substitution of a biological insect for a robotic one will have on the entire ecosystem. Similarly, entomophagy advocates a transformation in the individuals' food habits to adopt the consumption of insects as a low impact alternative to resource-draining meat products. However, this transformation is sold to the individual through well-designed food and designer's insect farm enclosures promising keen consumers to breed their own insects in a "sanitized", "leakage-free" and "contact-free" environment. These invitations come with no warning about the danger of overproduction and no advise about how to dispose of insect waste, thus perpetuating the idea that not only insects are creatures that bear no function other than being at human's service, but that become acceptable and acquire value only when incorporated into design or technologies.

In the second case, the buzz world "sustainability" – uttered at any occasion in press releases and in advertising of insect-related technologies – is a debated term subject to very different interpretations. Sustainability pertains to the condition and the assessment of what is or can – potentially or realistically – be obtained through the modulation of the interrelations between human beings, nature and technological objects (McManus 1996; Robbins 2004).

While being widely discussed in the context of environmental politics, the notion of sustainability extends to the areas of economics, finance, and labor studies, often fitting existing or ideal belief systems. The multiplicity of applications of this term has turned it into a contested notion: in

fact, the meaning of what is "sustainable" is modulated differently according to competing discourses that prioritize either the environmental development of sustainability or sustainable development (McManus 1996, 49). The term "sustainability" seems to be arbitrarily attached, on the one hand, to words such as ecology or conservation; on the other hand, it is associated to growth or innovation.

It is by using development and growth as synonyms, McManus observes, that the notion often bypasses the wasting habits of ceaseless production and accumulation in the name of a "controlled use of material resources and better distributed costs and benefits in a more equitable manner than had previously occurred" (McManus 1996, 53). In turn, its use is justified in the context of a particular *apolitical* notion of ecology that claims, according to Robbins, that "ecological problems and crises throughout the world are the result of inadequate adoption and implementation of "modern" economic techniques of management, exploitation, and conservation" (Robbins 2004, 9). This way of thinking is driven by the belief that "economic growth (sometimes termed 'development') can occur alongside environmental conservation" (Robbins 2004, 10).

The ambiguous interpretation of the notion of sustainability makes the establishment of universal criteria for its understanding and application impossible: the term is then used to estimate and condemn various degrees of imbalance-causing activities such as the unregulated consumption and depletion of natural local resources or the overproduction of waste from particular activities (Sullivan 2013). Conversely, sustainability is used to estimate and praise the economic or labour benefits deriving from these very same activities. The resulting rationalization of human and non-human natures comes to "conform to an economic system that privileges price over other values, and profit-oriented market exchanges over the distributive and sustainable logics of other economic systems" (Sullivan 2013, 200).

This interpretation brings to a third aspect that qualifies the insect industry as a product of human exceptionalism rather than an attempt to re-think its main tenets: the development of insect-related products and design seems to be tied to ambivalent motivations. Behind its noble commitment to sustainability, it appears to use insects as a way to draw attention to, and magnify the reactions of awe and enthusiasm regarding the latest emerging technologies and scientific innovations, thus effectively mitigating or even silencing any concern or unwelcome criticism these technologies raise.

Quoting white papers and scientific data of reputable world organizations advocating the human consumption of insects (van Huis et al. 2013); condemning the imminent extinction of bees (Greenpeace 2015), or showing statistics about the mortality rates due to mosquito-born diseases (Brady et al. 2012), the insect industry has found an audience willing to listen. Enticed by their drive towards innovation and their sleek and ingenious design, these audiences are easily lured to buy into a classic

technological trap: the fact that technologies will fix the world. What the audiences are willing to forgive is the fact that these new products may be new, but do perpetuate the same economic imperatives that stand at the basis of Western Late Capitalist systems, namely, the idea that "Capitalism grows through investment and innovation in commodity production accompanied by necessary expansions of populations of producer-consumers" (Sullivan 2013).

A number of scholars have associated this type of rhetoric to the rather essentialist notions of "greenwashing" or "ecobranding", that is, how large multi-national corporations have assumed the appearance of a "green" ethos to further their corporate aims (Parr 2009). These terms are used to denounce false claims of sustainability promoted by corporations, multinationals and governments. However, I would like to propose a more nuanced interpretation. It appears that the insect industry is often driven by a genuine desire to improve dramatic situations. Where it falters, however, is in its belief in what Evgeny Morozov (2013) calls "solutionism", that is, to think that it is only by inventing increasingly advanced techniques and technologies that we might be able to solve the impending problems threatening our bees, our environment and our health. According to Morozov, solutionism is "An unhealthy preoccupation with sexy, monumental and narrow-minded solutions [...] to problems that are extremely complex, fluid and contentious [...]. Solutionism presumes rather than investigates the problem it is trying to solve, reaching for the answer before the questions have been fully asked" (Morozov 2014).

Thus, I want to desist from using the above terms as they often convey a degree of intentionality that not only does not describe accurately the nature of the insect industry, but also dismisses the nuanced relations between insects, technologies and sustainability culture.

4. Sustainable Ideas, Consumerist Desires: Entomophagy and Visionary Design

On April 2013, The Food and Agriculture Organization (FAO) issued a report documenting the detrimental consequences of the decrease of forest resources and the disappearance of farmland due to excessive cattle breeding. "Land is scarce and expanding the area devoted to farming is rarely a viable or sustainable option. Oceans are overfished and climate change and related water shortages could have profound implications for food production"(van Huis et al. 2013), the report announces. "To meet the food and nutrition challenges of today and tomorrow," it continues, "what we eat and how we produce it needs to be re-evaluated. Inefficiencies need to be rectified and food waste reduced. We need to find new ways of growing food" (van Huis et al. 2013, 14). A viable solution, ac-

cording to the author, is to embrace entomophagy (the consumption of insects) as a sustainable alternative to meat (van Huis 2013).

Although it has been a common practice in a number of countries in Africa, Asia, and the Americas, entomophagy was never assimilated by Western culture. On the contrary, it was rejected as a primitive and unpalatable culinary option: as insects "seem doubly other – other than humans and other than the animals that we eat as well" (Loo and Sellbach 2013, 13), they are also associated with colonial assumptions of primitivism and "un-civilized" behavior (Mullin 1999).

Early efforts sought to encourage the consumption of insects by promoting their nutritional properties such as their protein-rich content. As early as in the Nineteenth Century, Vincent Holt encouraged the consumption of insects by classifying them on a scale of palatability that distinguished between vegetarian insects (edible) and non-vegetarian insects (non-edible)(Holt 1992). However, these arguments didn't seem to be convincing enough, as general culturally-induced disgust and fears of literally becoming "what we eat" or, as Loo and Sellbach suggest, to become "what we eat *eats*" (Loo and Sellbach 2013, 15), continued to prevent the adoption of entomophagy.

Interestingly, the FAO report appeared to trigger a partial inversion of this trend, by shifting the issue from being just a choice dictated by taste and culture, to being a responsible decision in the name of sustainability; and by using scientific and technological innovation as means that would enable this transformation to happen. In fact, since its very beginning, the FAO report insists: "Insects offer a significant opportunity to merge traditional knowledge and modern science in both developed and developing countries" (van Huis et al. 2013, 25).

By mentioning the role of science as a key protagonist in the quest for a sustainable future, the report solicited a number of creative responses from sectors such as the culinary sciences, food design and packaging, industrial design and the DIY community. Generally, innovative design was identified as the key to achieve sustainability, as it could be used to successfully make insect consumption suitable to the Western palate. This strategy emerged in two distinct yet correlated sectors: food design and industrial design.

Food design start-up ENTO Box Ltd. (UK) aspires to introduce insects into the Western diet gradually, by presenting them in the form of aesthetically pleasant treats that *de facto* conceal the familiar shape of the insect while drawing attention on the clever and attractive design of its composition and package (ENTO Official website, n.d.). The company, whose name originates from an abbreviation of the word entomophagy and the popular Japanese lunch box going by the name of "bento", produces bite size, perfectly shaped and tastefully colourful pieces delicately arranged in an Asian-style tray. On their promotional webpage, ENTO claims to "overcome people's preconceptions and create a world where edible insect foods are an enjoyable, everyday reality". They continue:

"We do this because we love great food, designing exciting new experiences, and well, the world we live in" (ENTO Official website, n.d.).

By selling their products as innovative and exciting, and by cleverly concealing their main ingredient, not only is ENTO Ltd. bypassing the sense of disgust that often deters the potential customers from trying entomophagy, but is also tickling their curiosity, effectively turning the food into a novelty. ENTO's promotional videos cite data provided by the FAO report as well as studies highlighting the detrimental impact of cattle breeding on the environment and on farmland. By doing so, the company effectively markets its products to a crowd eager to contribute to making the world more sustainable, without however missing out on taste and without participating in any activity that would imply sacrifices or engaged action. Thus, the project of sustainability becomes secondary to food experience and enjoyment, as the customer is motivated by the consumerist desire to try a new product, rather than by awareness and by a wish to make a real contribution to the environment and to sustainability.

Following similar conceptual and promotional patterns, a number of DIY and high-end industrial design projects rose to popularity right after the FAO report was released. Among them, Katharina Unger's "Farm 432" (Unger, n.d.), Jakub Dzamba's crickets "Circle Chirp" bioreactor (Dzamba 2015a), and Mansour Ourasanah's "Lepsis" (Ourasanah 2012; Boyer 2015) employ ingenious industrial design to introduce entomophagy into the common household. Manifesting ethos and rhetoric comparable to the rising digital fabrication industry (Moilanen and Vadén 2013), these endeavors vow the dissemination of products that enable raising insects at home for personal consumption, that is, independently from the industrial intermediaries existing on the market.

The three designers propose that each household acquires an insect bioreactor, a vessel consisting of compartments which can be detached and separated, in order to ensure the development of each stage of the lifecycle of different insects (soldier flies, crickets, grasshoppers) from egg, to larvae, to pupae, to full grown adulthood. This method also facilitates the collection of the adult insect for human consumption while leaving behind its eggs, which will then hatch and continue a potentially never ending reproduction process. In all cases, each vessel is designed to assure a safe and sanitary environment for both insects and humans, requiring minimal management and space. According to these designers, the insect bioreactor is like an innovative kitchen appliance (like a yogurt incubator or a bread maker): having such vessel readily available at home would guarantee the owner autonomy, as he/she would be able to enjoy a continuous source of protein-rich food, while effortlessly contributing to sustainable culture.

Katarina Unger for instance suggests that owning an insect bioreactor (Figure 1) serves two functions: it "creates not only a more sustainable future of food production, but suggests new lifestyles and food cultures", enabling "people to turn against the dysfunctional system of current meat

production by growing their own protein source at home" (Unger, n.d.). Her idea for a black soldier fly bioreactor, she explains, originated from concerns regarding the overpopulation of our planet. Using FAO and similar reports, Unger points out that at this pace, by 2050, production of meat will have to increase by 50%, a goal that can't be reached as we will soon run out of crop fields dedicated to feeding meat-producing animals (van Huis et al. 2013).

Fig. 1 – Katharina Unger, *FARM 432 Insect Breeding*, bioreactor prototype.

Motivated by analogous concerns, architect Jakub Dzamba created a cricket domestic bioreactor (Figure 2) as part of a project for the future of farming in the third millennium, which he imagines will take place at home, thanks to easy-to-install cricket reactors made of re-cycled material. Cricket reactors, Dzamba claims, "are domestic modules, meant for household and office space, designed to house a population of 10,000 crickets, utilize local household biowaste, such as kitchen compost and yard waste as feed, and produce a regular supply of food-grade crickets"(Dzamba 2015a). As in the tradition of DIY makers and fabricators, he sells relatively cheap kits that the user can assemble at home. In this way, he hopes to fulfil his vision of "Third Millennium Farming".

Fig. 2 – Jakub Dzamba, *Household Cricket Reactor*, video still from http://thirdmillenniumfarming.com/-

Finally, Mansour Ourasanah proposes an elegantly designed grasshopper bioreactor (Figure 3) that can be adopted to avoid the environmental destruction and the potential scarcity of food that will likely occur in a few decades, should world consumption of meat and food waste increase at the current pace. For the US-based, Togo born designer, adopting entomophagy is neither a matter of taste, nor simply a choice, but an act of responsibility toward the environment and the product of an increasing awareness about what we eat, especially in the West.

It is easy to praise the commitment to ethics of conservation and waste reduction of the above three examples, as they emphasize the contribution that single users could make in creating a sustainable, zero-footprint and autonomous cycle of continuous production and consumption. Their focus on modifying our food consumption's habits by drawing attention to taste, positive futuristic scenarios, and visionary and clever design is, indeed, a persuasive strategy that works, especially in a society, like ours, unwilling to renounce comfort and privilege to embrace a more balanced, yet less satisfying lifestyle. After all, the bleak future predicted by the FAO report is a hypothesis that a limited number of people is willing, or prepared, to believe and to accept.

However, by adopting said strategies, these designers fail to address directly the transformative changes they seem to be hoping to obtain in their advertisements and promotional messages. In fact, their messages are mostly product-oriented, focusing on the contribution of the single individual, rather than the community; they exalt the design of the food over the food itself; and prioritize the ownership of the object-bioreactor

over the potential value of the insects – the latter being left in the background, only portrayed as the content of the bioreactor, rather than the main subject of interest. In other words, their messages appeals to the potential user as consumer, rather than as a person with responsibility, luring her/him with a product that can be purchased or built, rather than trying to foster her/his motivation and commitment.

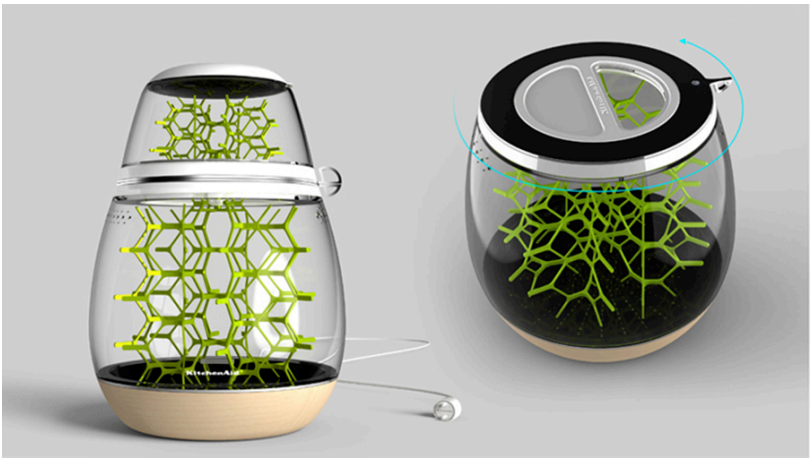

Fig. 3 – Mansour Ourasanah, Lepsis, *Insect Breeder*, from http://inhabitat-.com/mansour-ourasanah-designs-a-vessel-for-farming-edible-insects-at-home/lepsis-1/?extend=1.

Second, insects are used to draw attention on, and to enhance the quality and the beauty of design and sustainability as innovation, and as objects that can only achieve the status of food thanks to design. The way that the insects are subordinated to design relegates them to being a curiosity, not a primary interest. For instance, in describing her project, Unger observes how her bioreactor, "enables people to turn against the dysfunctional system of current meat production", but never mentions that a transformation would be only triggered through a shift in our eating habits. Furthermore, the designers collective behind ENTO emphasize the beauty and style of their well-packaged products, a way, they admit, to hide the insect content in an attempt to make it more palatable to the Westerner's sense of taste and expectations.

In addition, no thought is given to the overproduction that the adoption of these bioreactors would cause, nor the multiplication of consumer products, despite the genuine commitment to the environment and sustainability incorporated into their messages. For instance, Dzamba appears to think of the entomophagy revolution as a *fait accompli*: his pro-

motional website (Dzamba 2015b) pays special attention to reporting about the productivity of his bioreactor as opposed to the waste of land and resources produced by traditional meat (poultry, beef and pork), thus partially dismissing the uses of crickets in food.

In his video, Ourasanah describes the difficulty of Western culture to modify its lifestyle (Ourasanah 2012). Abundance and overproduction leads to the assumption that selecting what to eat is a choice, and not a necessity. In this scenario, transforming people's eating habits becomes a challenge if it is presented as a matter of commitment or as a decision implying some form of sacrifice. The examples described so far respond to this apparent impasse by using design as an incentive: the individual will accept the new habit because of its design, or because of the gadgets accompanying it. In some way, the use of design to lure the individual-as-consumer is a sign of resignation, deriving from the notion that no commitment to environmental causes and lifestyle changes can succeed, unless it is associated to practices that reproduce the models of consumerism and accumulation grounding our culture.

Thus, although one should acknowledge and even praise the enthusiasm for the potential environmental benefits of these ideas and the new technologies and industrial applications that the above projects generate, these benefits are always tied to principles of ceaseless growth, constant reliance on innovation and the production of increasingly new design, as well as obsolescence, as newer design models would probably be released as "improvements" in the future to supplant the original bioreactors.

The applications merging insects and technology acknowledge the coexistence and mutual dependence of insects (as animal/other), technologies, and the human. However the very focus on individual choice and on lifestyle clearly demonstrates how their mandate and goals not only are focused on the sole improvement of the human species, but they also tend to prioritize – for necessity or for choice – the technology and the innovative product over the insect that has inspired it.

5. The Quest for the Ultimate Solution

5.1. Disappearing Bees

On May 2013, in the wake of recent concerns regarding the widely documented decimation of bees, a press release from Harvard's School of Engineering introduced Robobees, a Micro Air Vehicles Project "inspired by biology" (Harvard School of Engineering and Applied Science, n.d.; Ma et al. 2013), consisting of a family of robotic insects which could be equipped, one day, with the ability to pollinate. According to the lab's press release, these state-of-the-art objects of micro-robotics could re-establish the ruptured ecological equilibrium left by the scientifically cor-

roborated and well-documented extinction of their biological relatives (Steffan-Dewenter et al. 2005; Wood 2009; Piore 2013).

The lab released a series of demo videos (Harvard University 2013), which were widely distributed online, and attracted the attention of the press, prompting questions of "whether particular forms of artificiality [...] were appropriate replacements for equivalent phenomena we have designated as natural" (Margolin 2002, 17); and whether the solution to the extinction of the bees could be found in the implementation of new technologies, or rather in the intensification of the battle for their preservation.

The issue has gathered both enthusiastic adopters, who regarded this technology as the new frontier in micro-robotics, and challengers, who questioned its ethics, accusing the Harvard's School of Engineering of opportunistically using an urgent environmental concern to obtain more media visibility and sympathy from the public; to conceal the real purposes lying behind such research, namely, the development of micro-robotics machines for military and surveillance purposes; and to advance a discourse encouraging the replacement of the natural and organic with the artificial and machinic.

Among the challengers, Greenpeace pointed the finger at the website of the Robobees project in its "Save the Bees" campaign, warning against the reliance on technologies to solve this environmental crisis and asking the question: "should we create a new world or save our own?" (Greenpeace 2015).

To raise awareness about the contentions that this project had prompted, in May 2014, a group of performers marched into the Micro-Robotic Lab at Harvard University. Reverend Billy, a performer known for his anti-corporate stunts as a pseudo-televangelist, led the group composed by the Church of Stop Shopping and Ethiopian-American activist Theodros Tamirat. Together, they had recently released an album voicing environmental concerns titled "Earthalujah" (Reverend Billy 2013). The group carried fruits and vegetables – all items available to human beings thanks to the labor of pollinators –which they offered to the Robobees, by laying the produce in front of a showcase where they were being displayed, chanting "These bees that are dying: we are asking you to place your genius, your research, your scientific know-how to save the honey bees" (Reverend Billy vs Robobees 2014).

Upon hearing the performers exhorting the scientists to redirect their research on saving the bees rather than replacing them, one of the scientists interviewed, candidly admitted that the purpose of the research had not at all emerged from a desire to replace the precious insects: "The story is that people are making small robots. That's an interesting technology that normally has lots and lots of uses. But now you want to sell that story, you want to get funding, you want to get coverage, so you have to tell a story. Hey! We are going to call them bees. Bees is a good story, but then if you call them only bees then Fox News gets upset, because you are

wasting money on bees, so you call them 'robot bees'" (Reverend Billy vs Robobees 2014).

Whether we examine the Robobees project from the perspective of the enthusiasts or the challengers, two aspects immediately emerge: first, the technology is both "producer and mediator of the bee as a specific scientific question" (Parikka 2013). In fact, the micro-robotics technology at the basis of Robobees is driven by the goal to imitate the bee (its flight, its size, its extraordinary ability to pollinate). In turn, it gains popularity thanks to the bee and its significance. In the case of the Robobees, the very relationship between technology and bees becomes the conjuncture around which technological and strategic decisions are made. What seems to stem from scientific data and public concerns about the alarming rates of decline of pollinators is conveniently coopted and used as a do-good motivation by the engineers at the Micro-Robotics Lab. In fact, by cleverly using the bees as its main subject, the lab temporary shifted the public attention away from some of the main sponsors of the project, namely the Navy, the Air Force and DARPA, whose goals are certainly more concerned with developing micro-surveillance devices for military uses, than with creating a new class of pollinators (Reverend Billy 2014).

It is micro-robotics and its promises that gain most traction, not the wellbeing of pollinators or the good of the environment. On the one hand, micro-robotics stands for innovation and improvement of human ingenuity, which is believed to enable us human beings to potentially master the functionality and complexity of nature. On the other hand, it constitutes a threat to nature. As we marvel at the shrinking in size of technologies and at their increasing precision at imitating nature, the extinction of the bee becomes of secondary importance. As Victor Margolin argues, the goal of technology in fact "is to improve upon nature to replace natural organisms and processes with artificial ones in order to increase overall social efficiency and profit" (Margolin 2002, 18).

According to Margolin, the reason behind this tendency is economical, that is "to spend more to produce economically valuable engineered species than to protect economically useless endangered ones" (Margolin 2002, 17). As the scientist interviewed after the Reverend Billy's action confirmed, building tiny robots and calling them Robobees guarantees more funding and visibility to the lab, than "merely" trying to protect the well-being of bees by using simpler and less sophisticated technologies and remedies.

Furthermore, bees are perceived as useful to the preservation of ecosystems and to human beings, since they make the production of most fruits and vegetables possible, by transporting pollen and seeds from place to place. While for Greenpeace and Reverend Billy bees are species to be revered and worth saving, for the scientists at the Micro Air Vehicles' lab they constitute an enough important species to be imitated. In all cases, there seems to be a shared interest in the ability of bees to pollinate, a quality crucial to the conservation of nature, which in turn is es-

sential to the human species.

This is an anthropocentric argument emerging even from the most well-meaning enterprises. In fact, the preservation of said quality, one may argue, can be pursued with or without bees, feeding in this way the urge to rely on technologies, rather than on other solutions. The preservation of the Earth, Margolin argues, "requires a profound shift in consciousness: a recovery of more ancient and traditional views that revere the profound connection of all beings in the web of life and a rethinking of the relation of both humanity and divinity to nature" (Margolin 2002, 19). However, this argument does not take into account the needs for human beings to survive our current economic climate, a system that advocates the use of technologies as a fix for personal gain, economic growth and material wealth, rather than for solutions that would strengthen the relationships between humans and the animal other (Fry 2008).

5.2. Proliferating Mosquitos

The conservation efforts of Greenpeace and the attempt at fabricating of the Micro Air Vehicles lab focused on saving and re-making a species destined to extinction. However, it is also worth considering how the opposite scenario – the attempt at exterminating an invasive species by means of innovative bioengineering techniques – manifests analogous rhetoric and rationales. Although using different technology and scientific knowledge, and addressing opposite issues, spread over extinction, the tendency to conform to the above joint economic/capitalist and anthropocentric principles can be also observed in the battle against mosquitoes.

Genetically Modified Organisms (or GMOs) are used in a variety of areas of research: bacteria are modified to produce insulin; transgenic seeds and plants are manipulated genetically for scientific research, to create new plants and crops; or for experimental medicine (e.g. gene therapy) (Newell 2003). However, they have been mostly criticized in regard to the production of food that went unregulated (or inadequately regulated) thanks to the complacency of the government and their relations with the biotech industry (Phillips and Isaac 1998). Public opinion regards the risks of GMO food on the human body as insufficiently studied, and deems the authorities unable to provide appropriate regulations that are both objective or reliable (Roff 2008).

Conversely, GMO plants (e.g. the Suntory blue rose) and animals (e.g. GFP Bunny, Glofish or transgenic mice for laboratory research purposes) have been welcomed somewhat differently. Whether produced for pleasure, entertainment or scholarly goals, these non-human creatures have elicited criticism and ethical questions, but they have never caused the same level of anxiety as GMO food. The worry caused by GMOs appears

to be directly proportional to their proximity to, and their ability to affect human personal liveliness and the human body: humans ingest food, and they are more likely to carry the future impact of GM produce on their physical health.

The case of GM mosquitoes as a solution to endemic diseases such as Dengue Fever or Malaria has been brought to public attention in a relatively recent article on the New Yorker which described the method developed by British biotechnology company Oxitec to modify the genetic structure of male *Aedes aegypti* mosquito, "essentially transforming it into a mutant capable of destroying its own species" (Specter 2012).

According to a number of studies, mosquito-borne diseases kill around 1 million people a year (most of them children) and affect more than 500 million people (Shah 2011). Currently, no effective cure has been found for Dengue Fever and Malaria, two diseases transmitted by mosquitos, and endemic in countries with tropical climate. With chemicals such as DDT becoming increasingly ineffective in destroying these insects, and climate change favoring their spread, finding new solutions has become an urgent problem. Most efforts have been dedicated to the extermination of these insects, arguing that their contribution to the ecology they inhabit is minimal.

The genetically engineered *Aedes Aegypti* mosquito, or OX513A, has already been used in successful trials in remote areas of Brazil, thanks to a collaboration between Moscamed, Oxitec (two biotech companies) and the University of São Paulo (Abumrad 2015). However, the steady spread of this species into the northern hemisphere and the increase of Dengue Fever cases in the South of the United States have convinced some local governments to initiate new trials and support from a portion of the population.

According to some sources, in 2009, Key West, Florida, suffered its first dengue outbreak in seventy-three years (Specter 2012). While there were fewer than thirty confirmed cases, as the population of the islands is limited, there was a main concern that this occurrence would damage its florid tourist industry.

The residents were faced with a dilemma: to rely on GM technologies to lower the mosquito population, or risk losing money and customers. Interestingly, the main concerns of the opponents to this trial were not about the existence of GM mosquitoes per se, but about the effects potentially caused if by any chance one of those GM mosquitoes accidentally bit a resident: would these mosquitoes affect the resident's DNA? The motivations behind choosing to welcome the trial and the types of concerns generated emphasize not only a reliance on technoscientific innovation as the only solution to a problem, but also its use to minimize commercial loss rather than human loss. In fact, as Michael S. Doyle, a resident of Key and an entomologist admits in an interview, "Part of our problem is the image of dengue. [...] A couple of hundred cases here could be devastating to the tourist economy" (Specter 2012).

I would also argue that using a state of the art innovative method to exterminate mosquitoes may be perceived more efficient and effective than traditional methods or non-technological solutions. In addition, the arguments in favor of the extermination of mosquitoes tend to be always skewed towards the conservation of humans and their economic well-being. No issues are raised about the contributions –if any—made by mosquitoes to the non-human ecology or the impact that their extermination would pose to said ecology. Given the bad reputation of mosquitoes, and the assumptions that this species only causes annoyances and damaging effects, the problem remain completely human focused.

5. Conclusion

The heterogeneous undertakings that constitute the insect industry appear to have enjoyed extensive media attention and popularity with the general public. However, despite their apparently well-meaning purposes and their admirable rhetoric, they do not appear to awaken any public responsibility towards the environmental challenges facing mankind in the next decades, or to generate a desire to contribute actively to leading a more sustainable and less wasteful existence. Rather, the insect industry appears to have benefited from both the subject (insects) and the technologies (state-of-the-art, innovative) they engage with.

In the examples I have described, designers, scientists and engineers successfully exploit the quality of insects as abject, yet enticing subjects, as creatures evoking "particular vicissitudes of our instincts formed early in childhood, which have acquired material properties of an external world of human and other than human forces" (Loo and Sellbach 2013, 20). In addition, they have accompanied this attention-grabbing subject with already popular emerging technologies. This move likely put them in a condition of advantage in regards to other designers and scientists working with similar technologies and innovative design, but engaging with less attention-grabbing and controversial subjects such as insects.

Thus, although the practices mentioned in this paper are apparently unrelated, since they engage with distinct fields of research and creative entrepreneurship, their emphasis on innovation and sustainability follows very similar discursive patterns and rhetorical strategies. As I mentioned early on, we should not dismiss these practices as yet another attempt at "greenwashing". In fact, in most cases, the choices to undertake insect-related projects originate from genuine concerns, or at least some awareness of the challenges posed by industrial overproduction, food waste and climate change.

Thus, the insect industry obeys and at the same time contradicts the imperatives of economic growth and the principles of technological innovation supported by Western culture. This tendency reveals a solutionist approach in its enthusiastic reliance in technologies, science, and design.

However, it also shows how considering alternative paths that go against this trust in technologies would be damaging to these designers and scientists' financial survival. Finally, as good intentions are trumped by pressing economic necessities, exceptionalism prevents us from seeing the relationships between humans and animal-others differently. As Sharon Kirsch notes "Man, like all other organized beings, is born, grows and perishes. But *Homo Sapiens* does not like to be "like". He can't imbibe it. So the thinkers of London and Paris encouraged Man [...] to mistake his proximity *to* other animals for dominion *over* them" (Kirsch 2008, 19).

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The Pilgrimage Goes On...

A Conversation with Liam Bannon about Humans, Machines, and their Interactions

Alvise Mattozzi
Free University of Bozen-Bolzano

Abstract: By recollecting memories and experiences of his 40 years career through Human-Computer Interaction (HCI), Computer Supported Cooperative Work (CSCW), Interaction Design, Participatory Design (PD) and more in general the design of information systems, Liam Bannon outlines a history of the relation between design-related disciplines and social sciences. Based on such history, Bannon explains his long-term engagement with the cultivation of human capabilities through design and reflects, more in general, upon the meaning of human centeredness in design, taking also into consideration contributions and questions proposed by Science and Technology Studies on these issues.

Keywords: Human-Computer Interaction (HCI); Computer Supported Cooperative Work (CSCW); Participatory Design (PD); Activity Theory; Interaction Design.

Corresponding author: Alvise Mattozzi, Faculty of Design and Art, Free University of Bozen-Bolzano, Piazza Università 1, 39100 Bozen-Bolzano, Italy – Email: amattozzi@unibz.it.

Introduction

Liam Bannon welcomes me on the first floor of the new building housing the Department of Information Engineering and Computer Science (DISI) at the University of Trento[1]. Not even the time to greet, and

[1] The original conversation was recorded on the 10th of June 2015 in Povo (TN), at the DISI building of the University of Trento, where Liam Bannon is Visiting Professor, also teaching a Doctoral Course on the design of learning spaces for the ICT International Doctoral School. The text has kept the informal style of the original interview, with some small revisions for clarity. Liam apologizes for any inadvertent misunderstanding of people's positions or factual inac-

he right away points to the corridors: "Look! Look! How can they still design buildings in this way? Corridors and closed doors – all the same. This place really does not afford anything but walking through the corridors into your own room. No encounters, no meetings, or other activities besides walking straight to your room".

His sensibility toward spatial designs that foster human competencies and skills become the topic of our talk, even before our conversation officially starts.

He already knows that the conversation will also tackle the issue of Participatory Design, about which he recently wrote an historical outline together with Pelle Ehn (Bannon and Ehn 2013). We already had the chance to talk about this paper one year ago, thanks to a seminar organized by RUCOLA[2], entitled: "The Participation of What?".

Because of this previous mutual knowledge, Bannon starts the conversation by trying to underplay his role in the Participatory Design movement.

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Liam Bannon: My role has often been the one of an interpreter for different communities of other communities' work. I always try to talk to a certain community about what I find interesting within another community. The problem with such position is that often people start to see you as being "the expert" in whatever approach I am trying to bring in to the community. I do not feel that this is quite appropriate, and I do not wish that all of their thinking about the topic is mediated by my (limited) knowledge of this other approach. I am quite happy to say, "This is what I personally find interesting". But, I'm not trying to claim expertise in all of these different areas. So, for instance, Participatory Design... although I have been connected with that community for sometime and I know many of the people who really helped to put it on the map – within informatics in the eighties and nineties – I am not the spokesperson for Participatory Design. There are many others much more qualified than me, with more practical experience. I do try to work in a participatory fashion in some sense with the projects I do, but it can vary quite a lot in terms of what happens.

curacies that may have crept into this text – it is just a set of personal, anecdotal reflections, captured at a moment in time. For more extended published articles on many of the topics raised here, please contact Liam Bannon at liam.bannon@ul.ie. Comments also welcome.

[2] Research Unit on Communication, Organizational Learning and Aesthetics, Department of Sociology and Social Research, University of Trento (www.unitn.it/rucola).

Alvise Mattozzi: Yours seems to be a sort of research journey through different communities and frameworks, a journey through which you do not only carry out your enquiry, but also connect different sites you happen to explore. You already framed your research in this way early on, in 1989, in a paper vividly titled: "A Pilgrim's Progress. From cognitive science to cooperative design" (Bannon 1989).

LB: Yes, with that paper I have tried to describe a bit what was driving me at that time.

AM: However, it can also be considered a sort of far-sighted program for the years to come.

LB: In a way yes, but I could not know that at the time...

I studied psychology and computer science separately, in the early seventies, and I became interested in the relation between the two. There were two levels, as I saw it: one was conceptual, like thinking of the computer, and computation, as a model for the mind, and that was the information processing approach, which was very dominant in cognitive psychology at that time. So I became interested in that, and in fact I worked within artificial intelligence, which was thinking of intelligence as a general mechanism which could be simulated in the computer. So that if we were able to build something in the computer, then we could assume that it simulated how we humans think, assuming that we are also information processors. That was one level of the interest of the relation between mind and computers. The other level was a more practical one, which is related to people having difficulty using computers. This was in the early days, there were people using punched cards for their computer programs, not really interactive systems, but I was just trying to understand some of the difficulties these people had in debugging programs... and I worked in a computer help centre, dealing with people and their difficulties in getting their programs to run, trying to understand how they saw the world. And so then I went to do my PhD in Canada, and that was with somebody – Zenon Pylyshyn – who was interesting to me as he had a joint appointment in Pschology and in Computer Science, and worked in artificial intelligence. He also had strong links with people in philosophy. So, I went to work with him. And, during the time I was in Canada, I started to shift, in terms of my approach, questioning this idea of thinking of the human as a computer, about the computational approach. Because like any model, I mean, it has strengths and weaknesses. But, I just felt that the weaknesses – to my mind – were fairly fundamental in terms of understanding of how people act in the world. You had, at that time this idea in artificial intelligence that the mind was a kind of brain with some inputs and outputs, like a brain in a barrel: there was no sense of what it meant to be a body, there was no sense of the social, and it didn't relate also to where meaning comes from, how do these symbols get meaning,

or value; so I began to have a lot of questions about this approach.

So I became interested in alternative frameworks, like thinking about machines in terms of being artefacts or media and from there to computer mediated activity. Activity theory was one framework that seemed to give me some handle on things that were different from the computational approach.

AM: And, then, you went in San Diego to work with Don Norman.

LB: Yes, I was there as a post-doc with Don Norman's group. We developed a loose framework for talking about what we called "user centered system design", and that was trying to put attention on the human capabilities of people, and on their psychological capacities, and also trying to get designers to pay more attention to who they are designing for. But, we still tended to think of the people using the system like users of the computer, not competent workers in their own right, and we also viewed them as our objects of study, like subjects in psychology experime that we instructed to perform tasks that we devised for them, and then measured their performance. We would ask them to do something that we would observe, often in lab conditions, and notice how they manage the task. But, we didn't really engage with them in terms of their everyday working life. So, it was a kind of user centered design, rather than a system technical centered design, yes, but, we were still psychologists talking about 'people using systems'. Thus, we tended to focus on some of their general psychological capabilities, not understanding really much about the task or the detail, even though we did look at tasks of course, in terms of task analysis. But, we didn't really understand their world. We were bringing them in, creating a task and getting them to do it – to our design. What we started to realize is that, although there are certain things that you can learn from this type of study – in terms of basic capabilities, human performance characteristics, they really didn't address a lot of the issues about what people found helpful or not in in the systems in their workplace. Also, we were not addressing people who were using systems in terms of discretionary use, those who weren't operators of machines, those who were doing tasks or using only certain applications through the system.

So, there was something that inspired me: I felt we needed to go out into the field, in other words to understand people in their actual context of work, and to pay more attention to the conditions under which people work.

I wrote an extended report, when I was in San Diego, still in the early days, it was called: "Extending the Design Boundaries of Human-Computer Interaction" (Bannon 1985) and I pointed to few different things there. One was this general notion that the design boundaries of HCI coincided, at the time, with what I called: "The Human-Computer Dyad", namely the individual person operating on a computer. That was

the focus when we looked at interaction, very much just the interface. But, actually, in the workplace what you discovered very often is that people are accomplishing work not only with and through a computer, but also with other people and other machines. So, the computer mediates... So rather than thinking of human-computer interaction, we might better talk about computer-mediated activity. And then the question was what's a good framework for studying this? The early HCI paradigm was very much focused on the human as an information processor. So, the mind was like a computer, and so you have the idea of input-processing-output, etc. So, the idea was that mind and machine were very similar, and we can talk about them in the same way. Whereas when you switch to talk about computer-mediated activity, people are accomplishing things but maybe a tool or a medium perspective becomes more appropriate. So, people are accomplishing things with artefacts in the world, and it's through various media, and they affect the way we communicate. So that suddenly changed significantly the theoretical frames one might be interested in.

So, for instance, Vygotsky in psychology, in Soviet psychology, talked about language as also mediating human thought, as a tool for thought, but also he talked about tools, artefacts in the world coming from a Marxist kind of thinking-dialectics. An understanding of the world where humans are active subjects. Vygotsky's and then Leontiev's work, you have this development of Soviet school of thinking called "cultural historical activity theory"...

AM: Which was quite practiced in San Diego...

LB: Well it was! And indeed I was also was exposed to it, not in the Cognitive Science group, the group I was in with Don Norman – that was still within the information processing framework – The Cognitive Science Lab – but through another professor in Psychology at UCSD, Mike Cole and his group. Cole's group was The Laboratory for Comparitive Human Cognition (LCHC), across in another building. I came across Vygotsky many years before in my psychology studies, but he [Mike Cole] was looking at the technology in this very different ways – as something mediating activity. I spent a lot of time over there, so that was influential. There was this whole idea of thinking of human activities in the world. How can you not start looking at the context in which activities are occurring? How can you not start looking at the fact that there is not somebody working with a single computer, but rather that people are using systems – for sending messages to others, or sending documents, or sharing and editing and working on them? So you would wonder: "How come we not talk about that in terms of the design of our systems?". In the early days, one issue was how difficult it was to work collaboratively on a document, for instance. You had versions and editing options, but from the very outset it was still very much an individual working, so try-

ing to collaborate through the system, was quite difficult.

On encountering field studies, it is also what got me interested in more sociological and ethnographic studies. We start saying: "Ok, we need to prove more ecological validity for the kind of studies we do, we need to pay attention to what is the world of work in which these systems are used". And so ethnographic approaches became influential in terms of understanding the workplace, and that led me into taking a course on ethnographic studies in the mid-eighties, and reading the work of people like Eleanor Wynn's on office conversation, and Lucy Suchman's work on human interactions around an 'intelligent' photocopier.

AM: In San Diego, working on the extension of the boundaries of cognition there was also Ed Hutchins, wasn't he there?

LB: Yes, there is an element of his work where he was combining ethnography and human activity, in terms of moving cognition out of the individual mind, but he was still using a computational perspective. It is interesting... it's expanding the information process beyond the individual, but still maintaining the information processing view, putting it out into the world, whereas the activity theory approach is different. The latter doesn't necessarily stress the computational aspect. Ed hadn't joined UCSD as a faculty member at that time although he had connections with Norman's group and with Cole's group. He was in the Naval Research Labs nearby. So when I was there we did meet on occasion... But there were also many other interesting people there: Aaron Cicourel was there and Roy D'Andrade, a cognitive anthropologist, and a linguist, Jeff Elman. So, there was an emerging kind of cognitive science orientation that would look more at the environment rather than in the mind, but it had not set up a new faculty yet when I was there in the early 80's. But there were some very interesting discussions.

So, personally, the time in San Diego was very influential, because I spent a lot of time amongst these groups talking with many different people. So, for instance, I took a course in ethnomethodology from, Bud Mehan [Hugh Mehan], who had been a student of Garfinkel, I believe... and, if my memory serves me right it was on his course he had as an invited speaker Lucy Suchman. So the first time I met Lucy was at that course, when she talked about some of her work at Xerox PARC. This was her early work on people having difficulties using the smart help on copiers. This was the basis of her thesis on plans and situated action, which came out in '87 (Suchman 1987).

AM: Well, San Diego was actually really the right place, then, in order to question the boundaries of HCI!

LB: Yes, sure! But that was just one element within my 'pilgrimage'. The idea of understanding what people are doing with technology and

looking at the ways in which people organize their activities with and through these technologies... and so moving from the idea of a human interacting with a computer to the idea of interacting with a technology as an artefact, a more complex artifact, of course: a machine is more complex than a tool, a hammer or something, but it can still be seen as an artifact, as a product of human activity and crystallized knowledge. Then this idea was the first element that spurred my move away from a cognitive-psychology-based HCI.

A second element that bothered me emerged more through listening to some people in the HCI community of the time, at the way they would talk about users – often considering them as naïve, and as stupid users. Even many of those who were supposed to talk from a 'user-centered' view would talk in this way. And this bothered me on two levels. On a first level, ethically: it is not a good way to think about your fellow human beings. I mean in general, not just in relation to technology and design, I don't think most people are stupid. And, on a second and more practical level, I think it is a very bad concept to start with. If you think you are designing for stupidity, you will design stupid interfaces, – you will produce that behavior you are designing for. And so, what does that mean in terms of trying to build something... if you think about somebody who is going to be using the system every day or whatever, the idea of being able to learn more while on the job, because you have made this very simplistic sort of interface that doesn't allow people flexibility, to take control of it, to shape it to their own ends. This bothered me.

By chance around the time when I was still in San Diego I met a couple of people who came from Scandinavia. Susanne Bodker was one. She was at Aarhus Unviersity in Denmark, and was visiting [the Smalltalk group] at Xerox PARC. I also met Pelle Ehn and Morten Kyng, who were working on the UTOPIA project in Scandinavia, on graphic workers and the design of better computer-based tools for newspapers. I thought that what they were doing was interesting, in terms of their work on participatory design – which was inspired by the Norwegian computer scientist, Kristen Nygaard What I found interesting in terms of my own initial sense of understanding of this, is that they were really working with a kind of user involvement in design, and wasn't it just user involvement in the design of technology, but there was an explicitly political angle to it, in the sense that you had management and labour, and management was controlling the technology and labour didn't really know that much about what the technology could do. So they were very explicit in their position: "Ok, we want to be consultants, computer scientists... but to work with labour, to work with the trade unions". This was something rather startling! You must remember that the Trade Union movement was very strong in Scandinavia at that time. They had started with educating people about the capabilities of technology, but then they became interested not just in terms of understanding the context, but rather in asking: why couldn't we have an influence on designing the future technology?

And that's when they became interested in some of the HCI and user-centered design work at UCSD, because they saw it as possibly fitting in with their concerns. I thought that it was an interesting idea having people involved in design, not just studying people. I became interested in that approach, and so I started interacting more with those people and discussing with them, and then they invited me to come and visit, so – after a rather long hiatus, a 2 year walkabout in Asia and Australia – I went to join them and learn about their work in Scandinavia. At around the same time, the mid-eighties, there was the emergence of the area called CSCW – computer supported cooperative work. This started out in '84 with a couple of people: Irene Greif and Paul Cashman in the US bringing together a group of people from mixed backgrounds from all over the world, interested in aspects of collaboration with and through technologies. So it included some people working in computer mediated communication, people like Murray Turoff, who worked on the notion of the network nation, but it was more than that, people like Doug Engelbart and his augmenting the human intellect project ar SRI, people in hypermedia, people working on shared databases. So there was a mixture of people, and they called this particular gathering in '84 "CSCW", Computer Supported Cooperative Work, without having really a conceptual frame for this term. But, out of that emerged a first public conference in '86. I wasn't there because I was travelling in Asia at the time (between '85 when I left San Diego and '87, I was travelling). The Second ACM CSCW Conference was held in 1988, and Lucy Suchman was one of the prgogramem chairs, if I remember right. She had at this stage become interested in the work of people in Scandinavia working on participaroy design. So here we had a a linking of some people in terms of ethnographic studies and work practices on one hand, and on the participatory design work on the other: so at the '88 conference there was a strong representation of Scandinavians, and I was now in Aarhus, so I also went to that conference. And so that became quite an important meeting place, both for developing the European approach to CSCW, and for the development of the Participatory Design (PD) Conferences, which started in 1990 in Seattle. I wasn't there, but I had a paper with some other people from Aarhus in the 1993 book from the 1990 PD Conference (Schuler and Namioka 1993) The PD conference then became a more regular event, so it kind of merged some of the PD and CSCW interests: these do not overlap, there are separations, but there were linkages between people in these communities. Because the notion, in general, is that if you have a large database you access something in it, but traditionally it was just you who individually access, and the system keeps a record that you access something. But who accessed before you, or after you, the idea that you might like to know or be aware of this, the ways in which the artifact might mediate interactions – there is no notion of that in the software.

But the other whole area in terms of CSCW was bringing together people from the social sciences, where the idea was: if we are trying to

build technology to fit into people's work practices, then we need to know their work practices, and so we need to investigate them, and so the interest in what was termed "workplace studies". And it just so happened that a lot of the sociologists who got involved in the CSCW area happened to have a strong ethnomethodological connection or foundation. And so, after a few years, the vast majority of work that you saw in some of the CSCW conferences from sociologists was almost exclusively ethnomethodologically-inspired, written up in terms of members accounts, mutual intelligibility, etc. So you had this kind of emergence of CSCW, PD. What was interesting then is to see the way things evolved.

At Xerox PARC, they brought a lot of very skilled computer scientists and developed the personal workstation, the "Alto", which was the forerunner to the "Star" and other machines. The Star was the first commercial release of kind of a graphic type interface (a GUI), that later inspired Apple's Lisa and then Macintosh. So there was a strong AI orientation initially, trying to make machine's intelligent. but that's also where Lucy Suchman was working during her PhD studies, and so she had quite a big influence on some of the people, like [Austin] Henderson, who was a very well known software developer there. He started to realize that maybe this approach to try to make the machine more and more intelligent might not be the way to go. Taking on board some of the ideas from Lucy Suchman's work, he realized that you are never quite sure what's going to happen, so that you can't predict in advance every possibility, and maybe we've to re-think how we build systems, to allow for people to negotiate through troubles, and provide resources for them to do so, and not have the intelligent system try to "guess" what the user is trying to do. So I find it very interesting to follow the trajectory of someone like Henderson, as his writings become more open and exploratory, as to how to build technologies that support people in cutomizing and tailoring computer systems. And if you look at some of his much later work he has a company called Pliant Systems, i.e. pliant, flexible systems. He workied with Morten Kyng on a paper on tailoring and customization (Henderson and Kyng 1992). So you had this interesting mix of a people from a US research organization like Xerox PARC and Scandinavian people interested in PD work and in CSCW.

So, in my view, Lucy Suchman was a very influential bridge between these groups. And I had known some of these people, but it's not that I was at the same level, I was a little bit more junior. From San Diego, where I did have some informal links with Xerox PARC people, then to Aarhus. Interestingly, after I got to Aarhus I discovered people from Xerox PARC, who were setting up a new research lab in Cambridge, UK – called Rank Xerox EuroPARC initially – also visiting in Aarhus, which is a kind of interesting mix of corporations and Marxist-inspired activity! A while later, I ended up working as a consultant in Cambridge for a while and that was interesting too. When that started, a lot of people working there were psychologists, studying HCI approaches, but within a

few years there was a complete shift, so that the people who came in were mainly sociologists, The British sociologist Bob Anderson became head of the group, followed on later by another sociologist, Graham Button – both of them ethnomethodologists. Other people who were connected with Xerox at that time, included Christian Heath, and also Richard Harper went to work there, and other people well known for ethnomethodology ended up having connections there – so there was really quite interesting swing from psychology to sociology, from HCI to CSCW, at Xerox EuroPARC.

AM: The interest of your personal history relies in the fact that it sounds as a sort of allegory – as was the original John Bunyan's *Pilgrim Progess* – of the recent history of design. The 70's and 80's were indeed a period when cognitive psychology emerged as the new partner discipline of design. Just think of the relevance and success of Norman's book: *The Psychology of Everyday Things* (Norman 2013). Whereas with the new millennium design started to dialogue more and more with social sciences, especially STS, of which today's configuration has its roots also in the workplace studies you mentioned. It really seems that you were always in the right place at the right time!

LB: Yes, I know. I sometimes make a joke about being a sort of Forrest Gump figure. I happen to appear in various pictures and people wonder: "What are you doing there?". Because I wasn't the driving force, far from it, I was a rather minor player, in these strange inter-minglings, but I was often in between these groups, acting as a kind of a mediator, as I had links with the HCI, CSCW and PD communities.

AM: Can you tell me about projects in which you feel you were able to put all this knowledge somehow together?

LB: It is not so easy. When I was in Denmark, also because I was not speaking their language (although everybody in the University also speaks English) it has not been always easy to fully collaborate on empirical aspecs of proejcts. Also during the time I was there, it was a time of transition – some projects were finishing, others were starting. I was not in the lead on those projects. Very often these projects started because somebody knew somebody and they were able to get access to a particular workplace. So in PD what you're trying to do is discuss with people about their current work situation, and also talking and showing how technology might create new possibilities, and then thinking about building prototypes. I think that some ideas from participatory design had a strong influence in the long run on HCI and one of them has certainly been paying attention to the necessity of creating prototypes. The idea behind it is that we are not going to get it right on the first time, so that you need to make a preliminary system, or part of the system, and have it

tried out by people in their work situation... rather than showing people abstract formulations – diagrams, charts, of what the system is going to be, which does not mean anything to them, you actually create some sort of a physical instantiation, even if it is fairly simple... just paper and pencil or even cardboard... but the idea is that through this material instantiation you can actually imagine working with this new system – you have a screen like this, you do this, you then print there, and people are then able to concretize what it might be like, then they can comment on it in a meaningful way... which is completely different from the idea of showing them a diagram with all these lines and arrows, which mean nothing to them. And that in the long term has had a big influence on many fields. But, the problem is that what happens when some approaches become popular, it just becomes a buzzword... "Oh, we do 'PD'", and it becomes banal, so somebody says: "We do participatory design", and you ask, "How do you do participatory design?", "Oh, we do user surveys, we ask people what do they think, and they are participating in our surveys", but well this not quite what we mean by PD!

Another issue is that we must be aware of some of the limitations of the work we do. We can get into difficulties by showing people g possibilities, which can be interesting but also can be dangerous, because what you do is to show people a desired future, but they don't have it! In some cases, the question is what power do they have to make it happen? and in some cases they do not have that power, so in a sense after the project is over, what are they left with? It is potentially a problem, because now they know their work system could be better, it is like an expectation that is not fulfilled...

AM: The case of design eliciting desires and questions is a very interesting case, contrasting with the idea of design as problem solving. And this idea of design is somehow similar to that of radical or speculative design as proposed by John Dunne and Fiona Raby (2001; 2013), except from the fact that Dunne and Raby usually work in an exhibition-gallery context, whereas you were working within actual workplaces.

LB: Yes, and this is something that people are concerned about in terms of long-term engagement with people in work environments. And this is difficult with the research funding models we have. So this is the kind of institutional problematic, you know, you've got funding for two years on your project, or even less, and you've engaged with some people in a work domain, and you start to work with them, you are taking their time and they are engaged with the idea. And sometimes you make a prototype and then and they say: "Oh, we like it, we want it". But the point is: it is not necessarily robust enough to give to people, or it doesn't fit into the current way they are working or whatever. And then it can be a bit of a let down... like in terms of what do we provide for the people involved... it can be an issue in some cases. Again, it has to do with building

with people, developing mutual trust and support having to answer questions such as: "Who are you? What are you doing? What are you looking to get from us?" And what will you do for us?". Even if people have the best intentions, it is not straightforward, there are a lot of practical issues. So, on one hand it's sort of ironic that PD has moved from being a very small number of people mainly in informatics, outside of the mainstream, who were not interested in publications, but more in working with the trade union world, to becoming gradually more mainstream and accepted on the academic front, and very popular, and so in a way some of the PD activity has become more mainstream within general HCI and user-centred design practices. This may be a good thing, but also thigns change over time, both internally, and also the external political, neo-liberal environment. Social democracy, and trade unionism are no longer as strong as they once were. In some case, PD is everything and nothing, and again, it's a sort of 'gentrification' process, as in the urban context, an appropriation, that makes it different from what you expected.

After Scandinavia, I went back in Ireland for a brief period trying to set up a HCI and CSCW consulting practice, but I found there was not very much opportunity for this kind of work in Ireland at the time (1990). Then I went back to Denmark, then I worked in Copenhagen again for a while again doing CSCW, and then I moved to Limerick and I tried to set up a CSCW center there, but it was very difficult at that time, there wasn't much funding in Ireland, and it was difficult to get funding to do field research, and I found it hard to get money from agencies or companies,. So after a couple of years that CSCW side of things reduced, and I moved into interaction design. Interaction design... what's the link wit hthe other topics? Well it's a bit tricky. Some people like Terry Winograd, who was one important person in the emergence of interaction design also was influential in HCI and CSCW and PD for instance, and people like Susanne Bodker also crosses these fields. What is new with Interaction Design (IxD) is the engagement of the profession of Design with various technology communities. They had really been separate, both in terms of professional training, traditional design, industrial design, graphic design, often in separate professional schools, not in universities. It didn't really had much to do with computing or interaction. But what you started to see was a lot of designers shifting from a focus on product to process and services, and they realized that the computer was becoming not just a tool to make things, but a processing element. So there was an interest on the design side – becoming more interested in the capabilities of these technologies. But on the other hand you had people on the engineering side who realised that the computing environments that were becoming possible moved them away from factory workplaces into homes and public arenas – areas where they had little experience or understanding. You have technologies such as ubiquitous computing and then suddenly computation leaves the computer box, the PC, and starts to become something that you can embed in the world and in the envi-

ronment. Then the issue is how do you mix the physical and the digital, how do you even think about 'augmented' desks: and so suddenly you are dealing with the presence of these things in your lives, it's not like simply *using* the technology or an application, it's actually living with the technology. So that the whole frame changes and we need to ask how do we design actual spaces that are now augmented with technologies? And actually back in my early Aarhus days, Pelle Ehn and I we came up with the idea of a kind of an exploratory student seminar on ideas from architecture and industrial design for people in software, in informatics. Pelle had an interest in the Bauhaus, in art and technology and the socialist orientation of that, and he thought: "What might a digital Bauhaus be?"... and I had an interest in architecture and planning, design ideas of creating spaces, thinking about inhabiting spaces, information spaces... and maybe we could get some ideas about the linkage between the physical and the digital. So we read various pieces by different people... we also used a collection edited by John Thackara *Design after Modernism* that had just come out, and had a bunch of interesting papers by people like Christopher Alexander, J. Chris Jones, and other design theorists that we found stimulating. The idea of interaction design became a place where we could explore ideas of human activity, human ways of interacting, embedded in new technologies. Thus, it shifts from the more engineering-focused work on the workplace. But again, there are some quite strong overlaps... some people like Terry Winograd who promoted interaction design also had a strong political interest in the work of PD, and he was one of the few supporters of the Scandinavian work in the US in the very early days. He also had an interest with Flores in the phenomenological approach, so that opened up again another idea of how we think about what computing is. "Do categories have politics?" (Suchman 1993). This brings us back to that debate between Suchman and Winograd that I helped bring together in the CSCW Journal, which several of us started in the early 90's.

To go back to your earlier question, in terms of particular projects in interaction design I was involved in, when I was back in Limerick... one was an EU project called "SHAPE – Situating Hybrid Assemblies in Public Environment". The focus of that was exploring ubiquitous technology, but it was part of a program called: "The disappearing computer" (DC). We wanted to move towards getting people away for thinking of 'using the computer', the PC or whatever, and instead, have them explore thworld through augmenting the world with computation.. And this particular project, in which our Interaction Design Centre at the University of Limerick was involved, brought a lot of interesting people together, along with other DC projects. Just like, in the early 90's, an EU CSCW project called COMIC, and lead by the UK computer scientist Tom Rodden was very influential in developing a European CSCW community, the DC programme helped creat an IxD European community. It was a very influential and significant project, and involved a lot of interactions, espe-

cially between some of the sociologists of Lancaster and software people. It was quite an influential project in the European CSCW, in which I was involved – I was still in Scandinavia at that time. And then, in the early 2000, this later DC project was SHAPE, in which we were designing museum installation: so there was a form of participation, it wasn't in the sense of 'full' participative design... in the sense that we talked with the curators in the museum, we did visitor interviews in the museum, we shadowed people, and so on. But we didn't exactly have a design team composed of a certain number of visitors or curators; we did interact with them, but the ideas came more from the design group. We thought about participation in different aspects of the study, and one of the elements was that we wanted to encourage engagement with the exhibits, we wanted to encourage people to question things in the museum, not just to think of the museum as a one-way device, you know, the place telling you how you should think about the past, or the people. We conducted the study at the Hunt Museum in Limerick: it's a museum exhibiting a large private collection, of Mr. and Mrs. Hunt. They had a huge variety of things, like Picasso's, Chinese ceramics, Neolithic bronzes, all sorts of stuff, some quite interesting. But what we tried to do, we still wanted to get away from this curatorial perspective of telling people things, so we discovered some objects in the collection that were of questionable provenance: what they were, what was their function, nobody knew! So we encouraged people, the visitors to the museum, to engage with these artefacts and think about what they were, and then we asked them to record their opinions, we tried to do that in a way that wasn't intimidating, by using a telephone-type device that was easy to engage with. And then we collected all the responses, and we played it back on a radio-type device and people could ear the opinions of others in real-time: so there was a sense of inclusion, a kind of engagement, in the sense of people participating in the outcome of the work... which was interesting, but not at the level of true participatory design. Here we have participatory engagment with the designed exhibits, so there is a n element of continuing the design of the exhibit through the involvement of the visitors – their contributions do become a part of the resulting exhibition, which is interesting So, we come back to the very issue of participation: what do we mean by it, what are we participating in, and under what conditions?

AM: From what you are telling, it seems to me that the issue of questioning, of raising questions is something related to participatory design, at least in your practice. Before you said: "through prototypes you question things: what if things were different?"... and now you say that you wanted people to participate through asking questions and raising doubts rather than provide answers...

LB: Sure, sure. These are fundamental questions concerning how do we think about the standard story or the rhetoric around participative de-

sign practice. One of the other things we should mention is that sometimes there was a tendency for people to think: "Oh, in PD you do certain things"... specific techniques... Robert Jungk's notion of Future Workshops, for instance, which is a useful enough technique in some cases to get people engaged, to have people start to talk in front of others, because it's a very simple way of identifying what is somebody's problem, what has happened in the current situation, and what is a possible future. So there is nothing mysterious about it, but suddenly you think that what some people want is just "give me the box of trciks (techniques) and we will implement that". And that's not really what it's about, it is back to the issue of how you're engaging with people; are you open to listening, as well as supporting some kind of enabling process? When you make something, what is it? It's about going on a journey, a journey of exploration, rather than thinking of something finished. I know you've read the design chapter that Pelle and I wrote: Pelle has become very interested in this idea, especially with Latour's work on things as assemblies and projects as matters of concern (Ehn 2008). And so he's been thinking in terms of social innovation, as well; this changes what we have today in terms of the meaning of participative practice, and trying to engage with different publics. It is quite a different space.

As for myself, my own recent work is focussed more on the issue of the replacement of human intelligence by machines. For instance, there are many projects that try to predict and control human action. I feel that such an approach tends to actually limit our design conceptual spaces. The relevant issue is spending enough energy thinking how it could be otherwise, how we could augment human capabilities in different ways. It seems that we do not even explore that space. Rather than augmenting, it is all the time: substitute, substitute... Even within most of the ubiquitous computing models, approaches tend to focus on ambient intelligence. So, we try to model people, we try to guess what your desire is, what your affect is, what your emotions are, and then we try to do things via the technology. It's a strange scenario when the technology is actually the actor. The person becomes passive. And this brings us to the old issue tackled by STS, and especially by Actor-Network Theory. The reason why I so strongly push on the actor perspective, i.e. the human actor, comes from what I was saying before. Which is saying: "look, people act!". Whereas much energy is spent on making the machine more active and all we want from people is their input: we just want to track them, to follow their movements in a room. Actually, they do not do anything. It is the system that tries to do everything: it opens the window, it turns the controls... Why? Why not say: "Look, we have this, we have ubiquitous technology, we can have sensors, we can hav systems pick up lots of data", but at the same time starting to think more creatively in terms of what people may want to do with that, and how people can shape and frame these things – turning data into meaningful information. What tools do we need to help people to engage with the material being collected – to organize, assem-

ble, see patterns etc.?. So to go beyond simply seeing people as mere assemblages within a system, I believe there are both philosophical and pragmatic problems with the AI and ambient intelligence story.

Instead, we could start to move within this other conceptual space, where we can start thinking of how do we represent data for people to interpret. In this way they could choose how they want to do things. Maybe in part they want to hand off to a machine, or in part they may say: "No, I want to control these things. I do not want the blinds to open automatically. I want to control it". It is in that sense that the human-actor-narrative has meaning for me. It is in this context of that debate.

These issues are very relevant in for instance complex systems. Sometimes, there is the danger of trying to blame the human actor for everything. It is not that people do not make mistakes, but the issue is why they make mistakes, what is the context, the institutional arrangement around the system's presentation of information. It is much more complex. For some people, the way we get over the underperformance of humans is to eliminate them through machines. But this is also problematic in many real world situations. We need to realise the over-automation can also be a problem in complex systems (see the book by Gene Rochlin *Trapped in the Net*). So, how do we think about these human-machine systems in interesting ways? I agree that the human actor is not the only "actant" in complex systems, and so this does make me interested in some fo the ANT formulations, although I feel my understanding of much fo this work is still very basic – but I am working on it ☺.

AM: I think that Latour and Actor-Network theory in general would not be so distant from your perspective: the main issue – very well pointed to by a recent paper published in Social Studies of Science (Sayes 2014) is distribution. It is a sort of misconception the one about opposing humans to machines, humans to non-humans. It has been a rhetorical gimmick to raise an important issue about human agency, with the aim not so much to praise machine or non-human agency but to take into account the distribution of agency. Thus, what you were saying it is not something that Latour could not agree on. So, instead of talking in term of human or non-human agency we could reframe the issues, following your concerns, in terms of designing systems that provide you with answers, even before you ask a question, and systems that allows you to explore the question, etc.

LB: Sure, sure. I've been working on this paper about human-centred design trying to question this concept (Bannon 2011). Within a particular context, it has meaning, especially historically. However, it has now become a sort of mishmash. It is even included in the ACM index of terms and it actually refers to just a mishmash of HCI concepts like hci, accessibility and a bit of visualization. In this reading, is not a conceptual construct. It has become more a convenience term in everyday conversation,

for talking about things. I myself, nowadays, also don't think it's a clear conceptual construct.

When I say "human-centred systems", what I actually mean is systems that don't just model the user – try to put the user into the machine in a way, but rather allow for some space of flexibility for that person acting in the setting. My concern regarding this concept is also why I started trying to work with people in STS, through people around me that are more familiar with this tradition. For instance, I have been very influenced by people like Susan Leigh Star, the way she frames issues, I find it very perceptive, very meaningful. More recently an Italian colleague now at Limerick, Cristiano Storni, has been gently trying to educate me about STS approaches, and I am becoming more comfortable with some of the concepts, but I still have a long way to go! I have no problem with some of the STS work that I've read at times. Certainly talking about the role of car bumps and traffic policemen and things like that... you know... yes, certainly I can see its relevance... I understand Latour in terms of getting beyond the standard, human-machine conception, the social-technical divide. I think it's certainly intriguing and I have no problems with certain accounts in term of talking about networks, but I find the strong symmetry argument, for instance, extreme. It's a step too far somehow... I can't quite integrate that in my thinking at the moment.

I am not certainly here to pronounce about, you know, what I think is right or wrong: it's really about the utility of the theoretical formulations in addressing some of the questions we have. I am interested in how do we understand the human-machine relation, the social and the technical relation. So, I ask myself: "How do we talk about technology?". The problem, as I see it, given that I am normally residing in computer departments is that when I talk with engineering and computing people, they talk about the technical, and the human is not seen within the technical. It is really about trying to understand how do we talk about these things, both at the macro level, like in the history of technology, and at the micro level. We can wonder about how to talk about technology following all these different people, Heidegger, Marcuse, whatever... but there is also a notion like computation, through which computers are considered as machines as well as humans. And, this concept allows to explore certain questions, but then it leaves other issues out. So, the question with STS seems to be not so much whether I can follow it, or I can understand it, but in some cases, I am not sure what to do with it, in terms of my design concerns...

AM: This issue of the utility of certain categories reminds me of my personal experience with student designers. I discovered that I have to rethink most of the things I tell them... I try to teach them, in term of their utility for design purposes, in terms of their translatability in design terms. But this is an interesting constraint that forces me to actually rethink many concepts and theories and question them on many more

grounds.

LB: Design... actually this is another reason why I got close to STS. To me one of the things is to get away from this notion of design as something that is done only through a creative act. I am not trying to trivialize the notion by saying that we are all designers. Clearly, there *is* a sense in which we are indeed all designers, in that we all shape our environment, we move desks around, we arrange artefacts in space, etc.... For certain purposes that is important, to think about our creative acts, the way in which we all shape, and move in, our environment. At the same time, there are certain skills people have who are very good at synthesizing, and taking ideas and exploring design space, and I appreciate those skills very much in certain people. But I don't like, as it happens for instance in architecture, this hubris that you find in some cases, where people state: "I am the (only) designer", " Design is my sole prerogative, it is my creative act".

That is why notions coming from STS such as "shaping", "infrastructure", etc. I think are helpful to show the imbrication of these things. Other notions such as the work involved in the construction of concepts such as categorization and classification (Bowker and Star 2000) are very important for people in computer science. The danger is that people in computing often take their model for reality. The people who build models are normally aware of the model limitations. The problem is that those models are picked up and used by other people. These people think the model is how the world is... No, it's not!

To think more about work in STS, that I find intriguing, look at Annemarie Mol. I found her work very inspiring. Her book, *The logic of care*, for instance (Mol 2008). I found it very insightful for my purposes. I think that is something very relevant for people who work in design and technology in terms of how we think about health. I am moving in this space, trying to discover, trying to understand, and if I look at my trajectory, I can still talk about it in terms of a 'pilgrim progress': pilgrimage here in its literary sense of a journey – not its religious significance. Some prefer to call this nomadism, but I do not agree, as nomads do not just journey, they move, but they do not move into the unknown, they move between known places So, that idea of travelling like the pilgrim, in the sense of exploring, of trying to understand, that's what I could say of myself. This is what I have been trying to do: articulating, over thirty or more years, how to talk about this relation between the social and the technical, the human and the machine; how to understand it. And I will be the first to admit that I still have a long way to go!

Speaking from within computing, I always wonder how we can get it so wrong, how do we seem to build systems of all forms, pieces of software, technology in general, buildings, whatever, that seem so unfit for people and their activities. And how is it that, notwithstanding the smart people working in technology development, with all their knowledge,

with all of their skills, we continue to do this. This is what I wonder about: what's behind it, what are the underlying models or, better, the underlying assumptions that lead to this mess?

And then, what is it to be human, when we think of it. We need to reflect about the implications of holding assumpions about the need to design for stupid people, for people that are thought to be non-creative. So here, many concepts from anthropological and sociological frames of understanding – members practices, members language, accounts, stories become useful in order to counter this idea of stupid users. Think of notions taken from activity theory or practice theory: looking at mediating activities by moving away from the technology *per se*, trying instead to support our practices.

These are all framework, approaches, concepts that I find useful. Of course you could say that many of these concepts are coming from somewhat conflicting perspectives. But I don't have a single position. And even though I am associated with this term 'human-centered" computing, or design, today I feel that the term, while of historical importance, is not as useful as we look forward, as a way of thinking about new forms of human-machine interweavings. And that is where my engagement with the STS community will I hope bear fruit in the next years – in terms of new ways of thinking about the design of socio-technical complexes. We need to work on listening to, and understanding, each other better!

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Neoliberalism and Technoscience: Critical Assessments. Farnham: Ashgate, 2012, pp. 246
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Neoliberalism and Technoscience: Critical Assessments. Farnham: Ashgate, 2012, pp. 246.

Barbara L. Allen *Virginia Tech University*

This book and its message does not purport to present a cohesive view of the relationship between technoscience and neoliberalism, but instead is a collection of a broad array of interpretations written by over a dozen scholars addressing this topic. The editors of *Neoliberalism and Technoscience: Critical Assessments* state that while, this "[t]heoretical and methodological pluralism may lose something in argumentative elegance", the variety of ideas seeks to be "thought-provoking" at the very least (233). I think the editors, Luigi Pellizzoni and Marja Ylönen, have taken on a difficult task by not inscribing the collection a bit more carefully with a more cohesive theoretical framework (13). While a plethora of ideas regarding the relationship between neoliberalism and technoscience may seem fair-minded and all encompassing, it left this reader wondering exactly what it was I was trying to understand. That said, there were some excellent analyses in this volume worthy of the importance of this political juggernaut in our contemporary world.

The term, neoliberalism, a key condition of late capitalism, should be defined before beginning any serious critique. I take as a starting definition that of David Harvey: "Neoliberalism is in the first instance a theory of political economic practices that proposes that human well-being can best be advanced by liberating individual entrepreneurial freedoms and skills within an institutional framework characterized by strong private property rights, free markets, and free trade"(2). The role of the state is to facilitate the construction of markets where they do not exist (i.e. water, pollution, carbon, health care, etc.) but to withdraw from any form of social provision through privatization, deregulation and the like. This is a fairly mainstream definition but, as the editors point out, there are many definitions to choose from when considering an analysis of neoliberalism.

The book consists of 3 sections, each containing 3 chapters on topics examining the governmental, institutional, and cultural aspects of the neoliberalism/technoscience relationship as well as specific issues regarding humanity/humanism and the environment. In the editors', Pellizzoni and Ylönen's chapter, "Hegemonic contingencies: Neoliberalized technoscience and neorationality", the premise gets at the heart of one of the problems in the book. They assert that studies of neoliberalism fall into two camps: those that examine the economic/political processes (i.e. Harvey's concept, mentioned above) and those that see it as a discourse between individuals, nature, and society – a sort of Foucauldian "governmentality" perspective. These latter approaches, argue the editors,, have opened up

deliberative processes in science and technology but at the same time such processes carefully construct their publics, a sort of disguised hegemony masquerading as democratic. These processes of co-option and obscuration of power combined with growing economic commodification and appropriation leads to a less-then-free public realm where agency is construed as entrepreneurialism.

In the chapter, "Neoliberalism and technology: Perpetual innovation or perpetual crisis?", Reynolds and Szerszynski make a strong and coherent argument that the new industrial economy is not new but, instead, a continuance of labor flows south and shipping containers north that has characterized global re-spatialization in the previous decades. The neoliberal knowledge based economy could be characterized by the financial speculation and creation of global financial innovations such as derivatives and futures that brought the entire market down in 2008. So instead of science as a new force of production, science is instead "cannibalized and privatized" such that it becomes a product itself (42).

Simone Arnaldi examines the promises and perils of human enhancement in his chapter on the intersection of transhumanism and neoliberalism. While the fountain of youth ethos and the push for the utopian body pervade transhumanist thinking, Arnaldi points to some darker elements in this evolution. Leaving our "political futures to be created as an aggregate result of personal choices", problematically envisions the market as mechanism for social coordination (99). The chapter includes a thoughtful analysis of the notion of perfectibility in transhumanism and neoliberalism in the work of Francis Fukuyama.

Providing another analysis of human enhancement, Imre Bárd's article contrasts the arguments of bioconservatives with those of transhumanists. The first group sees human enhancement and the drive for bio perfection as impinging on human dignity and potentially creating severe injustices and political imbalances. On the other hand the technoprogressive thinkers argue that humans have always enhanced their performance with technology and this era is part of that continuum. The latter position is closely aligned with neoliberal capitalism and the "rise of enterprise culture" leading to the autonomous, self-governed "entrepreneurial self" (126). He concludes with the very interesting question of how we can understand human enhancement differently once disentangled from politically problematic neoliberal narratives.

The final section of the book covers one of neoliberalism's strongholds in technoscience and governance — environmental issues. Les Levidow et al. show the influence of neoliberal politics on the emergence of sustainable biofuels policy in the EU through the use of supposedly benign market mechanisms to guide production and use. A technological "fix" developed to define *sustainable* biofuels has been the creation of carbon cycle accounting. This lies at the heart of the EU's "Low-Carbon Economy," a policy concept fetishizing carbon cycles as the prime indicator of sustainability" (165). The overall impact of this technological fram-

ing has been to depoliticize the agendas inherent turning biofuels "green" while at the same time marginalizing other voices, including those from the global South and critics of GM agriculture.

Nicely expanding the carbon market debate is Anders Blok's chapter, "Configuring *homo carbonomicus*: Carbon markets, calculative techniques, and the green neoliberal". Carbon markets have become "core sites of the contentious entanglement of new techno-scientific knowledge, neo-liberal market-based policies, and public concerns with environmental risks" (187). Expanding the often optimistic governmentality approaches to neoliberalism, Blok points to the plethora of technoscientific institutions, mechanisms, and emergent expertise necessary to sustain carbon marketization while simultaneously shaping political subjectivities and resistance. He argues that *homo carbonomicus* is at the same time an imperfect neoliberal subject and, following Boltanski and Thévenot, an embodiment of several moral grammars of worth or ethico-political standpoints.

Several days ago I spoke with a U.S. Environmental Protection Agency (EPA) official whose job it was to regulate industrial hazards. He explained to me that given the current anti-regulatory spirit (i.e. neoliberal political "lobbying" from industry) in the US, the agency had to think of creative ways to regulate. Besides the agency's declining funding there was additional pressure not to *do* anything. The EPA official explained that their new approach was to innovate in terms of making more data available to citizens to use as they want. His hope was that the agency could work with data specialists to help design ways in which an inordinate amount of environmental data could be made understandable and useable by non-experts. So as in Harvey's definition of neoliberalism, the EPA is not regulating in the traditional sense, but instead is relying on the entrepreneurial citizen with free access to information to make choices for themselves. From a governmentality perspective —an approach espoused by some in this volume — the EPA could be seen to be enabling a civic participatory realm full of deliberatory opportunities and democratic promise. I have serious doubts that this will be the outcome.

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Charis Thompson
Good Science. The Ethical Choreography of Stem Cell Research.
Cambridge (MA) & London: MIT Press, 2013, pp. 343

by Lorenzo Beltrame *Institute for Advanced Studies on Science, Technology and Society, Graz, Austria*

Stem cell research has attracted a great deal of scholarly reflection, both in the field of Science and Technology Studies and in bioethics. This is mainly due to the high level of public and political debate surrounding its regulation, triggered primarily by the complex ethical issues related to the use of the human embryo for deriving a particular kind of stem cell (namely human embryonic stem cell – hESC). The controversy over the legal and the ontological status of the human embryo, and its contested usability, has represented the main ethical, political and social issue in this field of biomedicine. Several scholars highlighted the overarching role of the embryo question, which would have overshadowed an entire range of concerns, problems and challenges in stem cell research and clinical application. Although prevailing, the embryo question is not the only controversial societal challenge qualifying stem cell research. Accordingly, STS and social studies of biomedicine have explored a variety of other challenges: quality control, clinical safety and effectiveness in therapeutic applications; standardization and validation in biobanking practices; social justice in access, affordability of available stem cell therapies and issues related to the procurement of embryos, eggs and cell lines (e.g. health risks for egg donors, inequalities and exploitations between the North and the South in the circuit of biomaterial supply). Therefore, the multiplex ethical, legal, political, social and cultural issues at stake, and their dense intertwinement with bioscientific practices and objects, make the field of stem cell research, and its regulation as much, a paradigmatic case of the ways in which science and society are mutually constitutive.

Charis Thompson in this book explores these overshadowed challenges in stem cell research, in order to outline what she calls "good science" or a science that has ethics – rather than a science that is simply dealing with ethics or constrained by ethical limits. After a decade of debates over the status of the human embryo in research on pluripotent stem cells (i.e. stem cells able to develop into any cell type of the organism, usually derived from the inner cell mass of an embryo), there is a tacit agreement on a fundamental disagreement on the embryo question, which turns the attention to other ethical issues.

According to Thompson, we face "the end of the beginning of human pluripotent stem cell research", where this research field is becoming to be normalized and standardized and thus new bioethical topics are emerging. It is time, then, to explore these topics and the "ethical choreography" of the process of consolidation of hESC research. Exploring the

ethical choreography means taking into account what kind of concerns emerge and gain public, political and regulatory attention, while others remain less visible. For attaining this goal, Charis Thompson develops an analytical framework based on the notion of "triage". Triage is the practice by which, in a hospital emergency department, patients waiting for treatments are classified and prioritized according to the seriousness of their condition and to the urgency of an intervention. Her approach aims at exploring how and why some issues come to the fore and are largely discussed while others are "left in the waiting room" (p. 12).

Her second goal is offering suggestions for establishing a good science in stem cell research. As Thompson argues, the book "takes a methodological and theoretical turn toward a more normative, policy-relevant approach to analyzing science and technology in society" (p. 9). In this sense, she criticizes the ELSI approach (ethical, legal, and social implications) in the governance of scientific research: problems related to the procurement of embryos and eggs for stem cell research are not implications, but preconditions. Similarly, questions arising from donation of biomaterials, standardization of procedures, access to therapies or participation in the value chain of this (bio)economic sector, as well as definitions of the role and rights of research subjects (as donors, patients, animal models or individual recruited for clinical trials) are part and parcel of the research itself. Charis Thompson invites to frame the ethics surrounding stem cell research into "the overall picture of health care" (p. 19) in order to better deal with ethical, social and economic issues arising in this field of biomedicine.

She notices that research on human pluripotent stem cells has taken place in what she calls the "pro-curial" frame, which (a) operationalizes the ethical problem within the procurement of biomaterials (i.e. human embryos, eggs and derived hESC lines) and thus solutions rely on ethically acceptable ways of procurement; (b) develops curatorial protocols and practices for managing the process of procurement; (c) deploys a procures rhetoric driving innovation and investment in this field (p. 29). Thompson discusses how the U.S. and Californian debate on human pluripotent stem cell research (the main case study of this book) has framed ethical issues in terms of procurement. What are the acceptable biomaterials (spare embryos leftover IVF treatments, embryos created for research purposes, stem cells derived from somatic cell nuclear transfer, adult stem cells, existing hESC cell lines)? And what should be the necessary bureaucratic procedure for attesting and securing the acceptability of these materials?

The strong point of Charis Thompson's work is that she shows how the problem of procurement does not rotate only around the embryo question. Problems related to donation of biomaterials, the exigencies of disabled people, disparities in access to health care, forms of benefit sharing of research outcomes, geopolitical differences in stem cell research and clinical applications represent issues that should be not only taken

into account, but also addressed to establish a "good science" in this biomedical field. For example, she explores and discusses the multiple issues related to the donation of biomaterials (e.g. embryos and eggs for somatic cell nuclear transfer) from the point of view of the health of women involved. She also addresses the well-known issue of property in donation: donated tissues enter in a value chain where donors have not a participation in the revenues and where the return in term of access to future therapies is not clearly defined. She discusses the problems related to the prohibition of compensation for donating eggs: while this prohibition is thought as promoting altruism, it clashes with the parallel market of gametes in IVF. This, in turn, may create a sort of market failure in biomaterial supply, which may be solved through a flow of biomaterials from countries with less strict rules on procurement and thus with exploitation of donors from these countries.

In addition, being this field of research supported by public funding, the return to taxpayers in terms of social justice and equity in the access to cure is a relevant issue, but scarcely debated and not sufficiently implemented into regulations. Thompson criticises the adoption of classical informed consent model for donation – which presupposes that the donor has rights neither in defining the research trajectory nor in the sharing of possible commercial outcomes. She, instead, claims that the emerging personalized medicine, and the development of epigenetics, calls for a strong and continuous interaction between donors and researcher. Thus, privacy and confidentiality appear as untenable. Similarly, the notion of withdrawal of consent is unfeasible in stem cell research: once stem cell lines are generated, it is impossible to predict what kind of pathways research and clinical application will take. Hence, Charis Thompson explores different consent models, where the interaction between donors and researchers is open-ended and forms of benefit sharing are envisaged. The author, thus, claims for a greater involvement of concerned subjects (donors, patients, investors, etc.) in every phase of human pluripotent stem cell research, in order to set up rules, procedures and practices answering to the multiplex ethical, social, economic and health care demands arising in this field of bioscientific research and future medical applications.

Although human pluripotent stem cell research in the U.S. and California is the focus of the book, another good point of Thompson's analysis is her exploration of different geopolitics of stem cell research, and her discussion of how the internationalization of this field and the competition among nations creates hierarchies that, in turn, could generate disparities and other ethical concerns. Despite the efforts of emerging international scientific organizations in the field (such as The International Society for Stem Cell Research) to establish international rules for quality and safety, phenomena such as that of stem cell tourism (i.e. ill people travelling to countries in which untested stem cell therapies are available) testify how the geopolitical pattern of stem cell research does not create a

horizontal international world, with a progressive standardization and harmonization of ethics and science practices. A world vertically stratified – not only in merely economic terms but also in access, affordability and safety of health care outcomes – emerges from her analysis.

Finally, in a very interesting chapter, the author addresses the issue of substituting animal models in research with in vitro cellular models. Using stem cells to study diseases and test drugs, indeed, implies not only the abandonment of exploiting animals or particular classes of individuals (e.g. prisoners or poor people through the clinical trial outsourcing in developing countries), but it could better fit the expectations of personalized medicine. In sum, besides the embryo question, a high variety of ethical issues are at stake in stem cell research, which should be addressed by regulations.

In conclusion, this book is a highly valued exploration of multiplex ethical and social issues and concerns involved in stem cell research, which are usually scantily discussed in public and regulatory debates (although they are not unknown in recent STS work on stem cell research). Its normative approach is undoubtedly useful to improve public and political discussion on this field of biomedicine and scientific research and, in general, for regulation and policy-making. However, in some cases, the book simply lists a set of ethical and social issues to be addressed, instead of proposing practical ways to implement them into regulations and into research and clinical practices. Furthermore, the analytical approach based on the notion of triage sometimes seems inadequate to produce analyses and explanations for the different attention gained by issues and involved groups' interests. In the book, it is not always clear why some issues are scantily debated and others gain prominence: Does it depend on cultural legacies, which prioritize some topics and silence others? Or does it rely on the power of involved actors in shaping the public and political agenda? The book, thus, seems more oriented to open a discussion with policy-makers and actors involved in regulatory processes, rather than scholars searching analytical frameworks for analysing and explaining the socio-technical dynamics shaping the making of a techno-scientific field.

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Tatiana Pipan (ed.)
Presunti Colpevoli. Dalle statistiche alla cartella clinica: indagine sugli errori in sanità [Presumed guilty. From statistics to medical records: an investigation of medical errors] Milano, Guerini, 2014, pp. 288.

Barbara Czarniawska *Gothenburg Research Institute*

Tatiana Pipan's anthology is a report from an ethnographically inspired study of medical errors in the Italian healthcare, conducted by a group of researchers from University of Rome 1, La Sapienza.

The introductory chapter by Pipan shows how controversial are data on – presumed – medical errors, when interpreted by the Ministry of Health, insurance companies, the Tribunal for Patients' Rights, and the Italian association of doctors wrongly accused of error (which uses the abbreviation AMAMI, i.e. "Love me" in Italian). Like several authors in this volume, Pipan used the concept of "boundary objects" (Star and Griesemer 1989). But hers is a study that reveals the ambiguity of the concept. Are "boundary objects" objects that are situated on a boundary, but, although interpreted differently, unite rather than separate; or are they objects that constitute a boundary, thus separating different actors? To use Pipan's vocabulary, are the statistics on medical errors liminal or limiting objects?

It appears that numbers, which are supposed to speak for themselves, fail to do so. There is a true "war of data" among various actors, perhaps because statistical data, like all numbers, are only quasi-objects, too soft, as it were, to create and stabilize peaceful connections among combating actors. But what type of object could play a stabilizing role? Pipan reports that the actors involved are considering a creation of an independent observatory, a digital infrastructure common to all (not an easy task), and/or a forum on which those battles can be fought systematically and openly. The media are obviously playing a key role in interpreting the data; at present in crisis, they prefer dramatic developments to peaceful resolutions. Will it change when the crisis is over? Most likely – with the change from paper media to digital media.

Francesca D'Angeli, Ester Pedone, and Barbara Pentimalli studied the role played by the many and varied digital medical records. A medical record is a special type of writing, a "chain of writings done by many hands", and it demands a special competence from its writers. A record can also be seen as a map of treatment; but, considering present trends in the European health care, will it be a map of treatment or – as suggested by Annemarie Mol (2008), who played with the semantic difference between cure and care – a map of choices made by the patients? The choices made will acquire greater importance if the legal appeals by patients become as common as they are in the USA. No doubt, however, that digi-

tal medical records have at least three functions: "memory", coordination (of cure), and, in the case of an accusation of error, legal evidence. Are they not in conflict, at least potentially? Was it always the case, or does the digitalization make the conflict more acute?

The next chapter, by Barbara Mellini and Alessandra Talamo, addresses the function of actual objects, not merely such quasi-objects as statistical data or medical records. These researchers examined nurses' equipment, in a search for objects that help to organize treatment. It turns out that some of those objects are formal and some have been introduced informally. Furthermore, there is a difference between professional nurses, who assist patients; and professionals of nursing, who organize treatments. A variety of objects – "objects-bridges", "dialogical objects" and "fused objects" – helps nurses to perform those tasks and stabilize the divisions. This further differentiation of the concept of "boundary objects" may be helpful in the concept's continuous use, making its ambiguity decipherable in a concrete context of application.

An interesting analogy also exists between formal and informal objects and the double bookkeeping routines, well known within accounting. No wonder: after all, the risk of medical errors demands a careful accounting of every task performed, but as in economic accounting, not everything can be registered properly according to formal norms. Both assisting and organizing require additional documentation, an "informal" one that cannot be presented officially, but which is extremely useful in practice.

In the chapter that follows, Carlo Caprari tells the fascinating story of a checklist that travelled from the field of aerial bombarding (1935 in the USA) on the wings of managerial fashions to the surgical theatre in a Roman hospital in 2004. Yet checklists are also quasi-objects of doubtful use. The solution conventionally applied is to improve the checklist or to create additional checklists. Checking on all important points soon becomes a ritual, and the longer or more numerous the lists, the more complicated the ritual. It does not reduce the actual complexity of the surgical theater, though; indeed, it becomes theatrical in the literal sense of the word.

In general, instruments such as checklists, provided by risk management – a recent managerial fashion – are perceived by the hospital personnel as "punishments and invasions". Caprari's interlocutors were often evoking the contrast between "art" (of cure) and "evidence" (alluding to another managerial fashion, that of Evidence Based Medicine). "Art" is doing treatment; "evidence" is the production of multiple quasi-objects that may or may not help the treatment.

Virginia Romano's chapter reports her direct observation of emergency services. Emergency services consist of three stages: the triage, the dispatch and the rescue. These three stages are documented on the emergence sheet, and Romano analyzed the role it plays: is it a documentation, a script for action, or both?

Emergency services can be seen as the epitome of organizing actions.

Triage – the assigning of degrees of urgency to wounds or illnesses – was originally launched in the 1930s by the French military for assessing wounds on the battlefield. It is an act of codification. Dispatch consists of translating the code into a script for action (Latour 2011). The actual rescue is heavily burdened by uncertainty about the accuracy of both the codification and the translation. Of course, organizing emergency rescue differs from most other types of organizing on at least two dimensions: speed and the cost of an error (that is, the volume of risk). But it is exactly because of these two differences that the study of emergency services – an extreme case of organizing – is of value in understanding organizing.

Barbara Pentimalli's chapter presents a fascinating case of disembedding: a travel of medical records from the hospital to the Tribunal for Patients' Rights. All of a sudden, the records become like Sumerian tablets, to be interpreted independent of the writers' intentions. Moreover, because they have been written by many hands, the records are an extraordinary example of what Mikhail Bakhtin called "variegated speech". It is not even certain that readers at the Tribunal would understand the dialects and jargons used in the clinical records, but they will certainly attempt to decipher them. The resulting interpretation may or may not coincide with the intentions of the writers, but this is true of all texts, including those written with numbers. Will all the parties involved in the interpretation be willing to accept this and other conclusions drawn by the researchers? A confrontation with the practitioners (who, hopefully, will be interested in the book) should tell.

The team's explorations are characterized by a meso-perspective: in-between the micro images of personal interactions and the abstractions of macro-theorists. In my reading, that perspective is extremely useful for practice and theory alike.

As to further research, the volume contains many threads that would be worthy of further research topics. It would be of great value if comparative studies were conducted in other European health systems.

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Mercedes Martínez-Iglesias (ed.)

Experts and Campaigners: scientific information and collective action in socio-ecological conflicts

València: Universitat de València, 2014, pp. 168

Paolo Giardullo *Università di Urbino, Carlo Bo*

This edited book by Mercedes Martìnez-Iglesias, University of Valencia, Spain, provides an opportunity to further explore the sociological debate about environmental conflicts. This subject has already been developed in Italy by different scholars (among others, Pellizzoni 2011; Bobbio 2010) focusing on the role of public participation in environmental decision making. The key feature of this research topic, as it has been approached in the existing literature, consists of connecting environmental sociology with social studies of technoscience. The link is made by the analysis of the use and/or endorsement of scientific knowledge as a strategic resource in a context of conflicts between groups. Conflicts may arise about the building of new important and invasive infrastructures (Lorenzet 2013; Bobbio 2010) or other environmental policy related interventions such as, for instance, waste incineration and management (Pellizzoni 2011; Bobbio 2002). As for these contributions, a specific relevance has always been recognised for the role of expertise and attempts to depoliticize the conflict as well as the production of new data by actors who oppose such specific intervention.

"Experts and campaigners" offers the opportunity to look at the Spanish debate on socio-ecological conflicts, which seldom overcome their geographical and linguistic borders. The book is written in English with the intention of tearing down language barriers; a symptom of the intention to move towards a more international debate.

The essays collected in the book are the outcome of a workshop on the results of a national research project about environmental conflicts in Spain, which involved also researchers from France and Ecuador; therefore, this book actually offers to the reader a privileged point of view about both the state of the art in the Spanish debate and about the empirical results of specific case studies. The added value of this book is the opportunity to resume in a single book the various theoretical perspectives about environmental conflicts and studies about the role of expertise and scientific knowledge: how it is embodied, endorsed and contested. The role and influence of expertise in environmental conflicts is the fil rouge that connects the nine chapters which compose the book.

In the introduction Martìnez describes the overall framework which the book applies; it is composed of three main areas: i) the reason why collective action takes place in ecological conflicts; ii) the features and role of scientific knowledge as a resource mobilised by the groups involved in conflicts; iii) the basic reasons for a change in the status quo.

These areas touch upon different fields of inquiry (i.e. social movements, social change and innovation) which traditionally have been analysed in sociological terms. In this case, Martinez explicitly declares the aim of putting scientific knowledge under the lens: as "a causal factor in social conflicts" (p. 9), the experts' discourse in conflicts, its effect in the dynamic of social movements and finally the general effect on social change. The empirical contributions deal with conflicts related to the long-distance power line between Spain and France (ch. 5) and the impact analysis of conflicts about water governance on environmental policies in Catalonia (ch. 6). Furthermore, interesting analytical hints have been provided by the study of scientific knowledge in configuring the environmental movement in Ecuador (ch. 4).

These studies and perspective recall classic STS themes, namely the scientific competence of non-experts (Irwin 2002; Wynne 1996) and the study of public engagement and participation (Philips et al. 2012). This opens the opportunity to apply the STS perspective with policy and governance problems for the management of commons such as water, and environmental planning. But what strikes the reader here is the concept of science to which all the essays in "Experts and campaigners" (also implicitly) refers to: the one proposed by Kennet Gould in the second chapter. Gould considers the nature of science as dyadic, distinguishing between impact science and production science. In doing so, Gould adopts Schnaiberg's category of a 'treadmill of production' (Schnaiberg and Gould 2000; Schnaiberg 1980) within which scientific activity is conceived as a mere apparatus; such a neo-Marxist approach considers scientific knowledge and its application as part of a productive capitalist mechanism, separate from society and yet able to shape it directly. Therefore, it is pretty obvious to find in the framework of this book the "causal factor" of social conflict. This vision of science obliterates almost thirty years of STS history, delivering a representation of "science" and "scientific knowledge" as an external factor, a kind of independent variable within a regression model.

The most recent generation of environmental sociology (Mol 2010) denies such a rigid approach, considering instead the crucial role of streams materiality, objects, ideas and people that perpetually reconfigure each other; a perspective that, through Urry (2000) openly recalls John Law, Bruno Latour and Michel Callon.

In concluding this review, "Experts and campaigners" offers us a two-folded opportunity: to explore a debate which clearly is interested in technoscientific issues applied to environmental conflicts and to explore how such hybrid research topics may be addressed more directly by STS. The book should be considered as a seminal attempt to analyse socio-ecological conflicts starting from the key role of scientific knowledge. It is certainly a fruitful approach but the way deterministic categories have been uncritically applied demonstrates how long we still have to go for a thorough integration of STS and environmental sociology.

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Christian Fuchs
Social Media. A Critical Introduction.
London: Sage, 2014, pp. 293

Cosimo Marco Scarcelli *University of Padova*

Over the last few years there has been a slow but relevant reconciliation of two different approaches interested in media and technology: STS and media studies. Both approaches ask similar questions concerning media and Information Technologies; however, they are rarely discussed together. Even though they can involve different empirical and conceptu-

al approaches, media studies and STS should be considered together in order to achieve a deeper understanding of the issues around media and technologies If the two studies were not maintained as distinctly heterogeneous intellectual spaces, a fruitful exchange could be started, with digital media as its base. The two traditions of study have coexisted for a "long" time, and new media could be their ideal meeting point.

For STS scholars, Fuchs' book is a good starting point in approaching media studies, and new media studies in particular. Even though it mainly focuses on a critical perspective, this book accompanies the reader in interpreting media theories and contemporary media studies. Unlike other textbooks, "social media: a critical introduction" is not limited to compiling a list of definitions of digital media, but it is a good overview of the field, explaining the different ways in which scholars can approach new media.

Starting from the title, Fuchs's critical perspective is immediately clear to the reader, referring explicitly to marxism and neo-marxism (the author distances the discourse from other critical approaches, for example in the introduction on p.7). This perspective places the distribution of power and resources in the centre of the discussion. In relation to social media, this approach (especially in the second part of the book, entitled "application") looks at exploitation and domination by studying the "political economy" of social media, and its "political communication". Fuchs' perspective studies the political economy at work by looking at the use of social media platforms like Facebook, Twitter and Google. The author shows that in the case of these examples, they both reflect the power structures of society (the capitalistic structure) and exploit the data that is provided to them for free by users.

Fuchs touches on many of the most debated questions in social media studies, such as the meaning of social media, the reality of participatory culture and participatory democracy, the role of power and counterpower, exploitation and surveillance on social network sites, the costs and benefits of what is usually considered free services, and potentials for alternative media. To chart this course, Fuchs divides "social media: a critical introduction" into three sections. The first is on the foundation of critical approach and concepts in media (social media, participation and power) needed for "critically understanding the world of social media" (p.1). In the second part, the author discusses social media platforms in the context of specific topics. In the last section he attempts to describe alternatives for the future, that he calls "truly social media". Every chapter starts from a specific key question that Fuchs attempts to answer through the field of social theory, critical approach and media studies. Fuchs starts with the fundamental question "what is social media?", and moves from a description and in-depth criticism to a basic concept debated in the context of social media theory. The first chapter is an important work in connecting social theory and media theory. In attempting to respond to the principal questions, Fuchs cites important sociologists, con-

necting what is today considered to be classical sociological thought to the analysis of what is the quintessence of modernity: social media, since "analysing continuities and discontinuities of the web requires social theory foundation." (p. 48). In order to achieve this, the author cites various concepts: Emile Durkheim's social facts, Max Weber's social action and social relations, Ferdinand Tönnies' concept of community, and Karl Marx's idea of co-operative work. Using these sociological key concept (that STS frequently contributed to rearticulate) Fuchs explains different understanding of sociality. Emile Durkheim's notion of social facts, for example, is useful to explain that "all software applications and media are social because social structure are fixed and objectified in them. These structure […] have an existence of their own, independent of individual manifestation" (p. 38). Than Fuchs remembers that according to Max Weber, social behaviour is a reciprocal symbolic interaction. In the Internet it means that only platforms that enable communication over spatio-temporal distance are social. Using Marx's approach, instead, web platform that enable the collaborative production of digital knowledge are social. In sum, by using different classical sociological theory Fuchs shows to the reader the different way to understand the meaning of sociality on the WWW.

Another concept analysed by the author is the so-called participatory culture, that he explains using and questioning Henry Jenkins's well-known notions of participatory culture and spreadable media. Fuchs also examines the concept of power, deconstructing Castell's approach and criticizing his position with the support of empirical research and theoretical speculation.

After a detailed introduction to the concept of social media and critical theory, Fuchs proficiently uses basic concepts he cites in the first part of the book to analyse specific social media platforms, and provides case studies on Google (chapter 6), Facebook (chapter 7), Twitter (chapter 8), Wikileaks (chapter 9) and Wikipedia (chapter 10). He writes: "we live in turbulent times that are shaped by worldwide inequality, global ecological crisis, war and terrorism, high unemployment, precarious living and working conditions, rising poverty levels etc. Can all benefit in this situation from social media? Or is it likely that only some benefit at the expense of others?".

Even though Fuchs writes through the specific "lenses" of critical theory in this second part of the book, the large amount of concepts and questions that he provides gives the reader a good idea of digital media and culture. Digital labour, privacy, surveillance, ideology, alternative social media, visibility, and the public sphere, are only a small group of key concepts that the author cleverly uses to achieve a closer analysis of social media.

In summary, this book gives the reader a good understanding of the main debates concerning digital media. The book is a good resource enabling those in the media studies field (including those studying a related

topic, as in the case of STS scholars) to have an idea of the principal debates concerning social media.

I would recommend that readers of this journal take a look at this book, as it is an opportunity to shed some light on the gaps that exist between media studies and STS. Even if there are no explicit references to the background of STS, those interested in science and technology studies will not struggle to find common ground with complementary reading in a field that, in my opinion, requires the encounter of such important conceptual approaches. Indeed Fuchs provides to underline the social aspects connected to digital media. STS scholars could find useful some of the author's indication to feed one of the fundamental tenet of STS: that material aspect of media and technology must be situated and studied within cultural, social and economic aspect. This book could give to the readers important tools that could be useful to bring back the social into discussion on media and technology. Finally, some of Fuchs' concept could be functional to a broader view that joins STS and new media studies because permit to say more about technology's largest social effect, without fall into technological determinism.

To conclude, it is important to note that the structure of the book allows the reader to navigate it easily. This is probably a greater advantage for students, especially as both the questions and the key concepts at the beginning of each chapter, and the recommended readings and exercises at the end of the chapter, transform the text from a simple book to a good starting point in approaching digital media studies.

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