The Bio-Social Event: Responding to Innovation in the Life Sciences

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Abstract

Rapid innovation in the life sciences calls for reflection on sociological practice in a changing research context. To this end we introduce the concept of the 'bio-social event'. It is commonly observed that some sets of life processes and social processes are more mutually relevant than others. We show that relevance and negotiability can also change *within* these relationships. Such changes, or 'bio-social events', lie at the heart of much bio-social novelty and innovation. We illustrate and explore the concept through two examples; meningitis infection and epidemic, and the use of sonic 'teen deterrents' in urban space. We set the concept in the context of sociological debate over bio-social dualism. We argue that the concept can assist in developing new forms of sociological practice focussed on critical but productive engagement with innovation in the life sciences.

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Many of the risks and opportunities that currently inform the strategies of states and other political organisations (Giddens 2009), that attract the attention of investors (Harvey 2010), and that generate public debate, emerge from sites of 'bio-social' relation (Lock and Kaufert 2001) where life processes and social processes, in all their variety, meet. Such sites include synthetic life (Regis 2008), human 'enhancement' (Harris 2007), genetic and epigenetic aspects of human and animal behaviour and well-being, the resilience of crops to drought, pest and disease, and causes of and responses to global climate change (Stern 2007). At these sites, the lifestyles and consumption patterns of human populations, processes of investment and capital accumulation, and governmental concerns for securities of resource and health are tightly bound up with organic processes of growth, change and reproduction in complex and shifting patterns. The rate of innovation and discovery at some sites in recent years has been startling, leading commentators variously to identify a 'molecular biology revolution' (Cooke 2004), a 'genetic revolution' (Clark 2005) and a 'new green revolution' (Rockström et al 2007). It seems reasonable to expect further developments in coming years.

In what follows, we consider how a long-standing sociological concern with bio-social relations can be deployed to develop a critical but constructive sociological engagement with bio-social innovation. To this end we develop the concept of the 'bio-social event'. This is a class of empirical events that are marked by change in the nature of the relationship between a specific life process and a specific social process. The field for potential use of such a concept is broad. We will focus on two examples to develop the concept and illustrate its use. For the sake of brevity, the examples chosen involve relatively familiar and well-documented life processes; a meningitis outbreak in Kano, Nigeria; and, the use of sonic devices in attempts to control young people's movements in the UK.

We develop the bio-social event in response to three concerns that are of broad significance for Sociology as a discipline. First, the rate of innovation at some bio-social sites has raised the concern that Sociology is simply being outpaced (Urry

2010). Second, is the concern that other disciplines, such as Economics (Shove 2010) and Bio-ethics, are enjoying greater success in responding to bio-social issues. Third, is the need to respond to the changing image of 'nature' where climate change and genetic science are making it increasingly clear not only that many life processes and social processes interact, but also that many life processes are alterable by deliberate and/or inadvertent human action (Latour 2004; Rose 2007, Serres 1995).

One response to these concerns would be seek 'higher ground' and to deal with them through theoretical argument about Sociology's relationship to nature. This is one way to defend Sociology's existing position. We have taken a different tack, however, aiming to create a sensitising concept for sociological practice. Many theoretical debates about bio-social relations are rooted in the question of the relative speed of change of life processes and social processes (Newton 2007). The idea that social processes are quicker to change than life processes has been used to support both attempts to defend sociology's intellectual autonomy and to account for social phenomena like gender and hierarchy in terms of human evolution (Buss 2008). As we will argue, however, bio-social novelty and innovation involve events that are governed neither by 'social' nor by 'natural' temporalities. Bio-social events are in this sense 'untimely' (Grosz 2004). We argue that whatever the rate of change typical within life processes and social processes, the points at which specific processes meet and relate have their own characteristics and pace. Understanding bio-social events and working with them requires an approach that has yet to be formalised either in social or in life sciences.

Quite how to address bio-social relationships has been a key concern of sociological thought since Marx drew on species-being in his critique of alienation (Foster 2000) and Durkheim asserted the autonomy of social processes (Durkheim 1982). More recently, a common way to innovate in sociological practice has been to distinguish between life processes and social processes within a given field. This has, for example, successfully established childhood (Corsaro 2004), gender (Wharton 2004) and disability (Thomas 2007) as fields of sociological enquiry with an emphasis on critical examination of representations of life processes and how they shape social life. However, for some (Haraway 2003, Latour 2004, Rose 2007) the recent wave of bio-social innovation and discovery is setting a limit to the utility of this approach, calling the discriminability of life processes and social processes into question. But careful consideration of how constructively to respond to bio-social innovation is needed. Simply to abandon any distinction between life processes and social processes would threaten sociological disciplinary identity and risks diminishing sociological articulacy (Newton 2007).

In what follows, we first suggest that bio-social relations need to be understood as diverse and as open, in many instances, to change. Describing a number of pairings of specific life processes and social processes, we argue that, as diverse as they are, bio-social relations can be characterised in terms of three common variables; the degree of 'relevance' each pair member has for the other; the degree of 'negotiability' within their relationship; and, the degree of 'novelty' of that relationship. We continue to deploy a heuristic distinction between life processes and social processes throughout our presentation. We do not, however, use it to define or defend Sociology's remit. Instead, our approach centres on a new analytic category of 'bio-social events', each instance of which is a point of inflection at which the relevance, negotiability and

novelty of a given bio-social relationship changes. We intend this category as a contribution to the extension of sociological practice regarding the bio-social beyond the critical examination of representations of life processes and toward constructive participation in bio-social innovation.

Bio-Social Relations: Relevance, Negotiability and Novelty

Distinctions between life processes and social processes need careful treatment (Latour 2008). They have, however, often helped sociologists to define their remit and to clarify the place of their discipline amongst others. The study of bio-social relations therefore demands a sophisticated response to the distinction between life processes and social processes. In this section we develop our response to the distinction and indicate how that response can contribute to the sociological analysis of bio-social relations, especially where novel bio-social relations are in formation.

For many social processes, such as socialisation of the young and the formation of social hierarchies, the fact that they take place at all depends crucially on the involvement of human organisms (Williams and Bendelow 1998). Likewise, life processes affecting such matters as global human population, health and life-span depend crucially on the character of social order (Wilkinson and Pickett 2009). It is clear that many life processes and many social processes co-exist and coincide, taking place as they do through and within human bodies. The nature of the co-existence of life processes and social processes, however, is no simple matter. They overlap to some extent, sharing some, if not all, of the materials they each involve. In practice it is not always easy to apply the distinction between them. Further, if we compare particular examples of the co-existence of life processes and social processes, it appears that this general 'overlap' is made up of many different qualities of relationship.

If one begins to count the human 'life processes' that are closely implicated in 'social processes' starting out with, say, the peculiar growth of bone and muscle that affords humans opposable thumbs and pointing fingers (Tallis 2010), passing by way of the autonomic control of appetite and its clever capacity to adjust to food availability (Winick 1988) and with the intention of reaching higher order cognitive skills like memory, it quickly becomes apparent that the 'bio-social' is a vast and complex field, even when restricted to issues of human embodiment and setting aside other dense clusters of bio-social relation such as agriculture, urbanisation, sustainable development and bio-diversity. Some order can be placed on the bio-social nonetheless. Considered as relationships between specific life processes and specific social processes, bio-social relationships vary in terms of the mutual 'relevance' of these processes, the degree of 'negotiability' within them and in their degree of 'novelty'.

First, there are differences in whether a particular life process and a particular social process affect one another at all. Some pairings have a clear effect on and 'relevance' for one another, others less so. For example, though food cultures vary widely (Germov and Williams 2008), the life processes involved in the digestion of proteins are, broadly speaking, the same for all humans. On the other hand, societal variations in alcohol consumption certainly do produce different profiles of liver function amongst different populations (Dalton et al 2010). Likewise, toenail growth is

generally irrelevant to the formation of social hierarchies, while children's maturation is the explicit focus of health and educational institutions (Turmel 2008).

Second, there are differences in the 'negotiability' of relationships between life processes and social processes. There are some instances in which life processes present a non-negotiable issue for social processes. Ageing and death, for example, have drawn responses from hominid societies for millennia (Finlayson 2009). Notwithstanding the forecasts of some gerontologists (De Grey and Rae 2008), this is likely to continue. There are other instances, however where negotiability is relatively high and similar outcomes can be pursued by different means. In human history, for example, the limited ability of the human body to maintain its core temperature has been supplemented by a wide range of foods and clothing, dwelling and heating technologies. Wherever relevance is more complex than complete determination of one process by another there will be a degree of negotiability.

Third, there are differences in the 'novelty' of relationships between life processes and social processes. Recent developments in the fields of biotechnology and climate change show that the novelty of relationships between life processes and social processes varies widely. Craig Venter's claims to have created artificial life (Regis 2008) may be overblown, but his work bears out the arguments Rose (2007) makes concerning the increasing politicisation of life processes at the molecular scale. If the majority of climate scientists are correct (Schneider and Rosencrantz 2010), then social processes of industrialisation have, over the last 300 years or so, established new connections between the ways humans eat, travel, warm and dress ourselves and the means by which relative concentrations of atmospheric gases are regulated by earth systems.

In recent years, a good deal of sociological concern has focussed on relations between embodied characteristics and the distribution of social goods and life chances. With a focus on human embodiment in relation to the distribution of social goods, the examination of 'relevance' and 'negotiability' gave sociologists a clear role, allowing for the articulation of progressive values against attempts to naturalize inequality. Thus, much theoretical and empirical work on bio-social relations thus far has been devoted to minimising the sense that life processes are relevant for social processes and maximising the sense that there is room for negotiation in bio-social relations.

Less attention, however, has been given to the sense in which bio-social relations can be 'novel'. It is not clear why this is the case. It may simply reflect a relatively slow rate of bio-social innovation and discovery prior to the early twenty-first century. It may reflect a long-standing Western cultural tendency to think of 'nature' as stable and 'society' as innately changeable. It is becoming increasingly clear, however, that while a static and determining 'Nature' has often featured in ideological depictions of the human condition and responses to human diversity, life processes, in all their variety, are often sites of change and invention. Both life processes and social processes can change and do so at diverse speeds (Serres 1995). For example, recent reports (Buroker et al 2010) indicate that processes of natural selection have, in 2,700 years since a major migration that split the populations, differentiated Tibetan and Han Chinese ability to cope with the low available oxygen in the air on the high Tibetan plateau. Today's Han immigrants to Tibet suffer lower birth rates and higher infant mortality than their Tibetan neighbours as a result. Further, both global climate

change and the emergence and spread of infectious disease mean that both slow and rapid changes in life processes now have pervasive impact on human intimate relations, communities and societies.

These examples speak to the intimacy and complexity of relations between life processes and social processes and to the innovation and novelty, anthropogenic and otherwise, that emerge as these relations shift and change. They suggest that the relative autonomy of life and social processes and their relative degrees of stability are context specific. For us, however, their significance lies beyond these matters. Crucially for our argument, no matter what relative speeds of change are *proper to* a given life process or to a given social process, change in the relationship *between* processes is not governed by them and can take place at an independent pace. Such instances of change in the quality of relationships between life processes and social processes, expressed in terms of relevance and negotiability, define the moments when a given bio-social site becomes a nexus of novelty and/or innovation. Sometimes, as in the case of Pasteurisation (Latour 1988) this innovation is, in part, the intended outcome of human activity. On other occasions, bio-social novelty takes humans almost entirely by surprise. Who, apart from a Svante Arrhenius (1896), would have imagined 100 years ago that industrialisation enabled by fossil fuels would establish a link between capitalist ways of life, the composition of the atmosphere, and global average temperatures?

Meningitis, commensality and disease

Thus far we have clarified our response to the, often useful, distinction between social and life processes. We have also begun to describe our analytic category of 'bio-social events'. In this section we further develop the category in relation to a meningitis epidemic.

The pharmaceutical manufacturer Pfizer recently concluded a decade-long legal dispute with a group of Nigerian parents by making a £50,000,000 out-of-court settlement. The case arose as follows: In 1996 there was an epidemic of meningococcal meningitis in a slum in the city of Kano, Nigeria that, eventually, killed more than 11,000 people. Many children were seriously ill. A Pfizer team arrived to set up an operation near a medical station run by Médecins Sans Frontiéres (MSF). The MSF station was distributing an established antibiotic treatment 'Rocephin'. The Pfizer team selected 200 sick children. Half were given injections of Rocephin and half were given pills containing 'Trovan' that was at a late stage of its development. Eleven of these 200 children eventually died. According to Pfizer, five died despite taking Trovan pills and six died despite being injected with Rocephin (Pfizer 2010). Parents of some Pfizer trial children later claimed that they had not given their informed consent to their children's involvement and that some died or suffered organ failure or brain damage as a result of treatment with Trovan. Pfizer maintains to this date that they had taken appropriate steps to gain parents' informed consent and that the harms described are possible outcomes of meningitis when any treatment fails. A number of court cases in Nigeria and the USA are still in progress.

The bacterium Neisseria Meningitidis (NM) was at the heart of this epidemic. NM normally lives inside human noses and throats without causing any problems. Estimates are that 10-30% of US adolescents and young adults are asymptomatic,

transient carriers of NM (Schaffner et al 2004). NM is often described as a 'commensal' bacterium, one of the many that have a symbiotic relation with humans (Haraway 2003). Many human life processes including food digestion and immunity to infectious disease involve such commensal bacteria (Marshall et al 2009). NM bacteria do not passively rest within human noses and throats but live alongside human cells and body fluids, interacting with them on a constant basis and drawing sustenance from them. In their turn, human cells, most notably of the immune system, actively respond to the presence of NM bacteria. Thus, where commensal relations apply, there is a constant busy commerce between human cells and NM bacteria.

Most often, these life processes are of little relevance to the social processes that involve whole human individuals. Where NM bacteria help to strengthen immune systems, commensal relations doubtless act as an enabling 'backdrop' to social life, but the presence of NM is by no means essential to it. So, in a state of commensality bio-social relevance is low and negotiability is high. In such cases, an heuristic distinction between life processes and social processes matches the empirical state of play. As long as microscopic biological phenomena and macroscopic social phenomena have little relevance for one another, and as long as their relations are characterised by high negotiability, life processes of NM commensality and social processes that compose daily life can be considered in autonomy from one another. Unfortunately, relations between NM and human tissues are not always commensal. Under certain conditions, commensality can convert to state of disease. As we shall see, in shifts from commensality to disease, the levels of relevance and negotiability between life and social processes both change. This is our first example of a 'bio-social event'.

Occasionally when NM meets naso-pharyngeal cells it multiplies so rapidly that it becomes an infection of those tissues. Inflamed and damaged tissues can allow NM bacteria to enter the bloodstream. When the bacteria reach the meninges - tissues that surround the brain - their growth can cause further inflammation, putting damaging pressure on the brain. As bacteria spread through infected blood, they can also infect tissues in vital organs, arms and legs. Where NM provokes disease in an individual, bacteria and human cells continue in busy commerce, but the results are such that they make a difference at the level of the individual human organism. Conversion from commensality to disease is registered *both* in the changing biological functionality of the individual (raised body temperature, tissue inflammation, reduced responsiveness to external cues and stimuli) *and* in the mobilisation of varying cultural distinctions between health and illness (Thomas 2007) along with other social resources ranging from family ties to neighbourhood social networks to professional medicine, depending on circumstances. Thus, the conversion of NM commensality to disease in an individual involves the forging of a new connection between specific life processes and specific social processes. On the small scale of one sick individual, this bio-social event is 'novel' in the sense that relations between the set of life processes taking place in her body and the social processes she takes part in have changed. Where once they were relatively autonomous - with low relevance and high negotiability - now they are tightly implicated in one another. The formation of this novel connection between life processes and social processes is, in our terms, one example of a wider category of 'bio-social events'.

Bio-social events and novelty

What we mean by 'novelty' in the context of an individual case of meningitis should be quite clear. Where, once, certain life processes and certain social processes could be considered mutually autonomous, the shift from commensality to disease involves a new quality of relationship. The descriptor 'novelty' holds good for each separate instance of an individual becoming sick. Yet, in Kano, these separate instances were hardly isolated, taking place as they did within an epidemic. Thus, one might press the question of how coherent this concept of 'novelty' is. Further, if our first example of bio-social novelty is an individual becoming sick, how can 'novelty' be applied to larger scale phenomena like the Kano epidemic? These are decisive issues for the use of the concept 'bio-social event' in such fields as genetic and climate science. The promise of repeatable and scalable innovations is part of what attracts investment and media coverage of genetic science and, in climate science, very large numbers of relationships between social processes and life processes are at issue. In our view, bio-social novelty remains a coherent concept as long as it is recognised that all bio-social relations, taking place as they do through specific materials, are local in nature (Lock and Kaufert 2001). This, however, does not prevent application of the term to repeated and/or large-scale events.

The first recorded meningitis epidemic was in Geneva in 1805. Just as the individual case of sickness has a history that is marked by a novel bio-social event, so does the class of meningitis epidemics (Crawford 2007). It seems that though individual cases existed before 1805, this was the first point at which life processes and social processes became linked on the scale of a whole city. When an epidemic takes hold, bio-social events that are local to individuals' bodies are not the only novel events to consider. Individual cases of meningitis involve a shift from commensal to disease conditions in individual bodies; epidemics involve a shift from a more or less steady level of endemic communicable disease within a population to a rapid spread of infection. Thus, there are additional changes in relevance, negotiability and novelty amongst specific bio-social relations to be taken into account, changes that register at the level of populations and of whole urban areas. The Kano epidemic offers examples of these additional changes.

By the mid-twentieth century meningitis epidemics had become particularly common in a so-called 'meningitis belt' that covers the Savannah region of sub-Saharan Africa, stretching from Senegal in the west to Ethiopia in the east. Epidemics within the meningitis belt tend to occur in cycles of between 8 and 14 years (Moore 1992). This has allowed the identification of a range of conditions that may, together, bring these cycles into being. Some of these conditions are life processes, some social processes. A brief examination will provide further illustration of changing levels of relevance and negotiability that accompany the bio-social event of epidemic disease.

Globally, NM bacteria occur in 13 variants or 'serogroups'. Bacteria in each serogroup share a characteristic surface structure. Human immune response to NM depends on recognition of this pattern. Most major epidemics of meningococcal meningitis involve serogroup A. As bacteria reproduce, their surface structure can change. It seems that changes within serogroup A pose particular challenges for human immune systems. One factor in meningitis belt epidemics, then, is the emergence of variants of serogroup A NM bacteria. Another is 'herd immunity'

(LaForce et al 2007). Individuals who are not themselves immune to a given NM variant are often afforded protection by being surrounded by those who are, since the higher the proportion of those who are immune, the less likely it is that those who are not immune will meet an infectious individual. Thus when a new serogroup A variant appears, this can infect individuals who have so far been immune to NM serogroup A, and also thereby degrade herd immunity. Further, many meningitis belt epidemics occur in the dry season between December and June. Dusty wind and cold nights can damage the nasopharyngeal lining increasing the likelihood of NM infection. Individual immunity can also be suppressed by poor diet, endemic parasites and upper respiratory tract infections. Social cycles in population movements for regular pilgrimages and traditional markets may also contribute to the phased spread of NM bacteria. Finally, high population density, as in Kano, makes rapid spread of infection more likely.

Thus, in the local novelty of an epidemic, specific life processes – those that determine herd and individual immunity and allow new NM variants to appear - and specific social processes – those that produce poverty, high population density and large population movements - come into high relevance for each other. Outwith epidemic conditions, the emergence of a new NM variant and attendance at a seasonal market can take place, to all intents and purposes, in autonomy from one another. Their new linkage is a bio-social event in the same way that the formation of link between the presence of NM and a parent's care for their child is a bio-social event. These events certainly differ in their scale and duration. They also differ in the level of bio-social negotiability that obtains within them. Individual sickness raises the mutual relevance of specific life and social processes. Where a sick individuals' well-being is valued and desired, its also lowers the negotiability that obtains in those relationships. Certain steps must be taken to try to preserve their life and health. In the epidemic conditions typical of the meningitis belt however, even though relevance between specific life and social processes is raised, negotiability remains relatively high since none of factors listed above is essential for an epidemic to occur (Moore 1992).

Bio-social innovation: engineering the 'untimely'

To summarise our discussion so far, a bio-social event is a local point of inflection at which the quality of relations between specific life processes and specific social processes changes. These changes may be in the level of relevance that processes have for each other and/or in the level of negotiability that obtains within their relationship. In our terms, variations in the quality of these relationships are what bring 'novelty' to a site. This does not imply that novel events are globally unique and unprecedented. Bio-social events are always local, but, like meningitis epidemics, similar events can recur over time. Further, just as an individual case of meningitis can take place within an epidemic, bio-social events of different scale and different quality can take place at the same time and can even be embedded within one another. Thus far we have focussed on bio-social events that take place outwith human intentions. We now develop the concept further by considering deliberate attempts at bio-social innovation.

As described above, the emergence of individual and epidemic meningococcal disease certainly involved human action. Large population movements to attend seasonal

markets, for example, certainly involve deliberate actions, but these are not directed toward the purpose of creating an epidemic. Likewise (saving the use of biological weapons) it is difficult to interpret the emergence of a new version of serotype A NM bacteria as the fulfilment of a human plan. So far as these relate to human action, they do so as adventitious outcomes. In this, they resemble both the genetic changes that distinguished Tibetan and Han Chinese populations following migration, and the increase in atmospheric CO2 levels attendant on the emergence of industrial societies. Many important bio-social events, however, are far more amenable to description in terms of human intention and design.

Some bio-social events, like sickness and epidemic, call for a response. When such events recur or are deemed likely to recur, routines may be established to direct and organise responses to them. The periodicity of epidemics in the meningitis belt meant that MSF were ready with stocks of antibiotic and that Pfizer were ready to send their own team. Both the MSF and Pfizer interventions involved the attempt to inflect bio-social relations to reproduce conditions of commensality between NM and human tissues. The Pfizer team were trying to do a little more than MSF, however. MSF were using an established antibiotic (Rocephin), while the Pfizer team were trying to engender innovation. Bio-social innovation involves bringing about novelty in the relations between specific life and social processes in one locale in such a way as to make repetition of that novelty easier in others. Given the untimely nature of bio-social events, however, this reliability is not easily come by.

We have already argued that temporality of 'untimely' bio-social events exceeds the schedules established by mechanisms intrinsic to life and social processes. This is what makes bio-social novelty and innovation possible. A corollary of this is that knowledge of clear causal processes alone is inadequate to understanding and to shaping bio-social events. The locale of activity established by attempts to innovate is similarly excessive. When cells, bacteria, Trovan, researchers, parents and children, are drawn together, bio-social innovation can take on a 'life of its own' with significant consequences. The untimeliness of bio-social events is prone to generating uncertainty about intentions and outcomes. In the Kano case these uncertainties allowed that issues of causality be performed on a moral and legal stage in arguments over who or what was to blame for childrens' deaths. These uncertainties are addressed, but not resolved, by the concept of 'informed consent'. The result is that Pfizer and the parents, who each stand to benefit from a new meningitis treatment, found themselves engaged in a legal battle. Pfizer's actions may be read critically as determined by a dehumanising profit motive. In our view another reading is available. For us the case indicates the need for an, as yet unformalised, expertise in understanding and dealing with bio-social events and their consequences, a need that is likely to grow with the pace and scale of bio-social innovation. We now consider a further bio-social innovation.

The 'Mosquito teen deterrent' and bio-social innovation

Since 2006 the UK company 'Compound Security Systems' has marketed a range of high frequency sonic devices under the brand name 'Mosquito'. They are designed to be wall-mounted such that a chosen area can be filled with an unpleasant high-pitched sound. The Mosquito is marketed as an 'anti-loitering' device promising to deter vandalism, petty crime and anti-social behaviour (CSS 2010). From the point of view

of bio-social innovation, its key feature is that it is capable of emitting sound at such a high frequency (17Khz) that individuals over 25 are very unlikely to be able to hear it. The device uses a peculiar feature of the maturation of human hearing selectively to target this unpleasant sound on young people so as to influence their movements without troubling their elders.

Within the inner ear, a coiled organ called the 'cochlea' contains numerous 'hair cells' that project from the surface of a membrane into a fluid. The stiffness of the membrane, and thus its resonant frequency, decreases along its coiled length. When the assembly of eardrum and inner ear bones transmit sound vibrations to the cochlea, the membrane resonates with these vibrations. This moves the hair cells with respect to the fluid, creating an electrical potential within the body of the cell. Collected and processed, these potentials enable hearing. Hair cells that respond to very high frequencies begin to die in late childhood, with the result that very few individuals over 25 can hear sounds above 16 KHz.

In all likelihood, older and younger people have differed in their ability to perceive sound at 17KHz throughout human history. Where age distinction has been key to social processes however, visual cues and identity documents have often been used to make that bio-social link (Turmel 2008) but susceptibility to high frequency sound has not. As a bio-social innovation, then, the mosquito makes high frequency hearing newly relevant for processes of young people's movement and rest within urban space. One factor in these processes is young people's desire to find spaces of autonomy from adult control. A mosquito activated by a motion sensor or a relatively distant human operator would tend to deny such a space to the young. The degree of negotiability within the newly formed bio-social relation is quite clear. The young can try to tolerate the noise so as to maintain their position, or they can adapt their patterns of movement and rest to take the new sonic obstacle into account. The innovation reliably establishes conditions in which this novelty can be reproduced across locales.

The production of device that can produce high frequency sound is no technical revolution, but the pairing of a life process with the social processes involved in the contested use of urban space as in the production, marketing and deployment of the Mosquito is a clear example of a bio-social innovation. It brings the near certainty of 'drowning out' speech between young people at certain places and times. It conditions communication between authorities and young people, by offering an alternative to the verbal request to 'move on'. The device denies reply. But the untimely meetings of age-related cochlear functioning and the contestation of public space that the device fosters also bring uncertainties. The device discriminates between old and young but not within the set of those capable of hearing it. Thus, an infant or child who has no intention of vandalism or loitering will be affected so long as they are in range of an active device, which, in many urban areas, is likely. Since its launch, vigorous media and legal campaigns have aimed at banning the Mosquito on the grounds that it infringes rights to free assembly and movement (Author A and Author B 2011). The result is that the sustained effectiveness of this innovation depends on it winning a string of legal cases so as to draw the line between 'deliberate' effects (for which CSS can be held responsible) and 'accidental' effects (for which CSS cannot be held responsible) thus confirming the legitimacy of its product.

The Sociological value of bio-social events

In each of our examples we have shown that bio-social events have peculiar untimely characteristics which, thus far, have placed them beyond the reach of formal enquiry. We have suggested that NM and Mosquito events are fair analogies for bio-social events at many other sites. 'Sustainable development' depends on attaining increased economic activity across the majority world whilst minimising or even repairing damage to existing ecosystems (Foster 2008). Innovation to promote some bio-social events and prevent others will be at issue here. A sociological imagination sensitive to bio-social events, could have a role not only in discussing proposed solutions, but also in devising them. Recent attempts to generate a bio-social innovation so as to link contemporary modes of capital accumulation with the carbon cycle through 'carbon trading' have had disappointing outcomes (Giddens 2009). Yet some such articulation would appear to be necessary. The concept of bio-social events could provide a practical corrective to the tendency of purely economic analysis to obscure material relations, not just as a critical voice but as a participant in the development of alternative techniques. It seems that antibiotic responses to bacterial infection have a limited future not only as resistant strains appear, but also as 'plasmids' that confer resistance are exchanged across bacterial species (Crawford 2007). How will sociologists engage in devising new solutions? Perhaps by forming alliances with those developing bacteriophage viruses.

Conceptual work alone cannot provide all the answers (Shove 2010). If, as we propose, the practice of Sociology is in future to involve participation in bio-social innovation, new professional skills and attributes will need to be developed. Careful consideration of which projects to contribute to will be needed. We note however that the disciplines of Bio-ethics and Economics each benefit from the availability of distinct 'travelling concepts' (Bal and Marx-MacDonald 2002). The 'ethical dilemma' and 'price' respectively offer them purchase on a wide range of bio-social issues. Our hope is that the concept 'bio-social event' is useful in easing sociologists' formation of new relationships between their existing strengths and those of other academic disciplines and new partnerships with relevant actors in public, private and third sectors.

The bio-social event in theoretical context

Thus far we have developed and illustrated the concept 'bio-social event' through two examples and indicated its potential for sociological practice concerning bio-social innovation. In this section we briefly set the concept in the context of two contemporary sociological approaches to bio-social relations, to clarify the stance it adopts within a key contemporary theoretical controversy.

Newton (2007) identifies anti-dualistic tendencies in contemporary Sociology that share the view that since the 'natural' and the 'social' are all material processes, there is, ultimately, no difference between them. In response, he defends a qualified dualistic distinction between natural and social processes on the grounds that social processes are intrinsically faster to change than natural ones thanks to the peculiar flexibility of symbolic systems. Our emphasis on the specificity of bio-social relations is in tune with his defence against biological reduction and his assertion of the value of distinctions in giving Sociology analytic purchase on the bio-social. For Newton,

the idea that natural processes change more slowly than social ones is critical. It is less so for us. Though timings of specific life and social processes are always important and we have no doubt about the value and pertinence of causal accounts in general, the temporality of bio-social events lies beyond Newton's concerns. Many life processes involve slow change. The age/frequency response curve of the human cochlea over evolutionary time scales is a good example here. Others, like the emergence of new NM strains, involve relatively rapid change. However, determining the typical speed, real or perceived, of change in life processes and social processes is not our main concern. Whatever speed life or social processes might be said to attain in their autonomy, the condition of a bio-social relation can change rapidly, as when Compound Security Services establish a new relation with human hearing. It is in this sense that bio-social events are untimely.

Latour (1993, 2004) is a prominent advocate of non-dualistic approaches to socio-technics and bio-social relations. In its emphasis on the irreducibility of the social to the biological and vice versa, the concept 'bio-social event' is indebted to Latour and many other non-dualist approaches (Tarde 1903; Whitehead 1978). Latour (1993) can be read as one of Newton's 'anti-dualists'. For him, nature/society dualism is a perspective that has been made possible only by an increase in the number and scope of intimate relations and dependencies amongst humans and non-humans. Even as this technological labour of 'hybridization' mixes human affairs ever more intimately with non-human affairs, a parallel labour of 'purification' takes place at the level of cultural representation to asserts humans' increasing transcendence over and separation from Nature in modernity. The concept of the bio-social event also deploys tropes of mixture and separation but does so a little differently. While for Latour (1993) 'purification' is principally a matter of cultural representation taking place on a different plane than 'hybridisation', in a bio-social event both mixture and separation of a given life processes and a given social processes and the switching between these states take place on the same plane.

Conclusion

As disciplinary landscapes change, as life sciences become a major depository of excess capital (Harvey 2010), and as bio-social innovation is variously demanded and deplored, sociologists have new opportunities. In sketching our response we were not directly concerned with producing a general statement about relations between 'nature' and 'society'. Instead, taking the view that neither 'nature' nor 'society'are unitary phenomena, we set out to examine life processes and social processes in the specificity of their relations. Though the distinction between life and social processes may, in practice, be difficult to draw, it is often, at the very least, of heuristic value. We argued that the life process and social process in any given bio-social pairing have a degree of 'relevance' to each other. Unless relevance is such that one partner is entirely dependent on the other, there is also a degree of 'negotiability'. Degrees of relevance and negotiability within a given bio-social relationship can change. The concept 'bio-social event' draws attention to such points of inflection in bio-social relationships and allows for their analysis.

Where a bio-social event takes place, it is possible to describe degrees and kinds of bio-social 'novelty'. Some, such as the sickness of one individual, are local to just a few people and have a brief history. The connection between fossil fuel based

industrialisation and climate change shows that others have a huge locale and are deeply rooted in history. Epidemics and climate change are composed of bio-social events that take place at some distance from deliberate human action. Where people and organisations strive to bring about a bio-social event in such a way that it becomes easier to repeat, we identify a bio-social event of 'innovation'.

This approach to bio-social relations strategically suspends any decision between theoretical alternatives of 'anti-dualism' and 'dualism' (Newton 2007). The key benefit is that it opens novelty and innovation within bio-social relations to analysis such that mutability of relations between specific 'life processes' and 'social processes' can become a guiding concern of sociological practice. Further, our concept identifies a class of untimely events which contain the possibility of change for the better, but which also create difficulties because they make causal control and clear attributions of intention and responsibility difficult to achieve. Legal process attempts to clarify such attributions after the event, but no formal expertise for dealing with the untimely bio-social on an ongoing basis currently exists.

This preliminary discussion has left us with at least three issues that require further attention but that lie beyond the immediate concerns of this article. First, it is our view that untimely bio-social events exceed description in terms of distinct causal mechanisms of either life processes or social processes. This in no way implies a rejection of 'causality', but further clarification of relations between causal mechanisms and untimely events, and of the degrees of freedom therein, is required. Second, in referring to 'life processes' and 'social processes' we have often suspended the question of the accuracy of knowledge claims made about these processes. One factor in the selection of our key examples was the relatively uncontroversial nature of the life science knowledge claims involved. Clearly the life sciences also involve more hotly disputed claims. Latour (2004), Stengers and Bononno (2010) and Thrift (2008) offer views of natural and social scientific practice as basically 'exploratory' rather than 'representational' that may help address the salience of this question of representational fidelity. Third, our coverage of exemplary bio-social events has been retrospective and qualitative in nature. Consideration of the use of quantitative data to characterise such events in terms of, for example, threshold effects, and the use of the concept 'bio-social event' in predictive and future-scoping work is needed.

Innovation in the life-sciences often seems to present Sociology with puzzles, barriers and threats. We hope that the 'bio-social event' helps turns the sociological imagination toward a series of new opportunities.

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