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Title: Sociology of the Multispecies Body
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Abstract: The human body has become a central focus in sociological theoretical concerns about the human in society. This work has centred almost exclusively on an analysis of issues relating to human embodiment and its significance in social contexts. This paper draws on sociological understandings of human embodiment to facilitate a multispecies understanding of bodies and their entanglements. The 'sociology of the body' has enriched our thinking about the human body in terms of conceptualisations of its fleshy presence and the ways in which human bodies are represented, displayed, manipulated and used. Bodies are fragile things and humans devote considerable resources and efforts to reduce this fragility. This is apparent most notably in relation to health and illness. Bodies can be added to, deducted from, manipulated, and altered as never before. In this regard, by means of the idea of the body as a project, sociology has examined the ways in which humans seek illness resolutions and lifestyles that are designed to limit the damage done to their bodies while at the same time increasing their youthfulness, beauty and endurance. Conceptualising the body as a project has provided sociological insights, as well, into scientific and technological innovations that are designed to improve health, reduce illness and delay death. Nonhuman animals are entangled in these efforts, though their presence is often occluded. By focussing on health and illness, this paper investigates ways in which

human and nonhuman animal bodies are entangled in order to present a sociology of the multispecies body that will augment sociology by enhancing our understanding of embodiment and its significance for society.

Introduction

In order to contribute to the imperative of 'A Sociology of Multi-Species Relations', this paper draws on the 'sociology of the body' to enable a sociological, multi-species understanding of bodies and their entanglements. It is only relatively recently that the body has become a central focus in sociology, but this work has concentrated almost exclusively on an analysis of issues relating to human embodiment and its significance in social contexts (Peggs K. , Forthcoming). The 'sociology of the body' has enriched our thinking about the human body in terms of its fleshy presence, of how it is experienced, and of about the ways in it is represented, displayed, manipulated and used. My question is this paper is - what about the bodies of nonhuman animals, which are entangled with our own in mostly oppressive ways?

Sociological perspectives on the body are pertinent to an analysis of how humans utilize nonhuman animals in at least three ways: a) in attempts to work on and improve our own bodies, humans often manipulate, transform, use, abuse and eat the bodies of nonhuman animals; b) in how humans often adorn their bodies with parts of the bodies of nonhuman animals; and c) in how humans use nonhuman animals as a way of identifying themselves as distinct and as superior. It is clear that nonhuman animals are central to the study of

society, as Clifton, D. Bryant (1979) argued back in the 1970s. But despite the recognition of human nonhuman animal studies in some quarters in sociology, the area is still seen as marginal (for discussion see (Taylor N. a., 2014). Because sociology has conventionally focused on humans alone (Peggs K. , 2012), human nonhuman animal studies entails challenging the conventions of sociology which, as Corwin R. Kruse notes, has caused some disquiet among sociologists (Kruse, 2002). The 'sociology of the body' has also been at the forefront of challenging the conventions of sociology (Howson, 2001, p. 297). Alexandra Howson and David Inglis argue that this is because 'the body' is used as 'a resource for broadening the parameters of traditional sociological thought' and for 'overturning that paradigm and fundamentally reorienting the assumptions and concepts of sociological thinking' (2001, p. 297). This 'seeing' of the body has facilitated the investigation of it as an object of sociological theory (e.g. (Turner, 1984) and has enabled sociologists to understand the body as a lived experience (e.g. (Williams, 1998). But these sociological deliberations have limited their dynamism to human bodies.

In order to explore the entanglements of human nonhuman animal bodies, in this paper I centre on the idea of the 'body as a project' (Shilling C. , 2003) that is worked on throughout life. Nonhuman animal bodies, like those of humans, are fragile and unreliable things. Humans devote a great deal of effort, time and resource to trying to reduce this fragility and unreliability. This is most obvious in relation to health and illness. Human bodies get ill and they die but they can be treated, added to, deducted from, manipulated, and altered as never before. In developing these health and illness related remedies, manipulations and transformations, humans have entangled nonhuman bodies oppressively and often invisibly. By focussing on health and illness this paper investigates the relations between human and

nonhuman animal bodies in order to present a sociology of the multispecies body that will augment sociology by enhancing our understanding of embodiment and its significance for society. However, this is not only for the purpose of enhancing sociological theory. It is intended, as well, to draw in an understanding of the lived experience of nonhuman animals and, ultimately, to boost a sociology that is *for* nonhuman animals (Peggs K. , 2013). To put this into context I begin by examining the turn to the sociology of the body.

Human 'body projects' and the 'turn to the body' in sociology

Since the late twentieth century there has been a marked 'turn to the body' (Shilling C. , 2016, p. 1) in sociology and social thought. In early work in the field, Bryan S. Turner (1984) reflected on the absence of the body in sociology and he liberated it as a legitimate area of sociological enquiry. Turner's work revolves around his notion of 'projects of the body' (1992), which resonates with Anthony Giddens's idea that, in late modernity, we have become increasingly 'responsible for the design of our bodies' (Giddens A. , 1991, p. 102). Our bodies have always been a central concern to us because our encounters and experiences are virtually always embodied (Smart, 1999, p. 111) but the relationship between individual identity and health, well-being and bodily image has changed (Shilling, 2003). Late modernity is characterised by an 'unprecedented *individualisation* of the body' (Shilling C. , 2003, p. 1), which is reflected in human anxieties about health and well-being and concerns about what our bodies say about us. The idea of the 'body project' recognises the human body as an unfinished phenomenon that is continuously under surveillance and that is worked on throughout life (Shilling, 2003). Thus, the human body is an increasingly

fertile site of social imperatives, alternatives and individual choice (Shilling C. , 2003) and the working on and transforming of the 'unfinished body' is an important way of accomplishing individual identity (Giddens, 1991). The relationship between the body and our identity, which is characterised by the individualisation of the human body that Shilling refers to, is a consequence of social changes in this current phase of modernity in which individual humans are increasingly required to construct their own bodies, their own individualities, their own lives (Bauman Z. , Liquid Modernity, 2000). We feel more and more anxious about the possibility that our bodies might let us down and this anxiety is central to the idea of the human body as a project that needs to be maintained (Shilling, 2003, pp. 35-36). Much of this anxiety is associated with the fear of illness and ageing (Gawandi, 2014) and no wonder, we live in times in which youth is valorised, and death is taboo (Bauman, 1992b). But illness and ageing are fundamental to living.

We feel that our bodies are threatened unendingly by unknown and often invisible viruses, malignancies and diseases. These are the 'problems of bodies themselves' to which Arthur Frank (1991) refers. Like all animal bodies the human body is fragile. Damage to it and deterioration of it are part of living, and fears about these necessary elements of living have driven the potential for, and further ambitions to, control the human body. Our body 'projects of health' (Shilling C. , 2003, p. 7) are especially important in this regard as they constitute 'an attempt to belie the ultimate limits of the body by breaking, successfully, it's currently encountered, specific limitations" (Bauman Z. , 1992, p. 18). Although our body projects are not restricted to projects of health - they also involve regimes of self-care that are associated with, for example, beauty – maintaining health and the staving off of illness are vital elements. Our body projects of health seem especially pertinent in an world that is

characterised by increasing concerns about a range of health-related hazards (Busfield, 2006) including those that are associated with infectious diseases (Dingwall, 2013) and a range of other 'health scares' (Hooker, 2010). Individual human health has generally improved (Busfield, 2006) but still we often underestimate our life expectancy (O'Dea, 2018) and our bodies features as increasingly *vulnerable* projects (Shilling, 2003).

Our health anxieties are exacerbated by developments in genetic research that enable predictions to be made about our individual probability of developing specific genetic conditions (Le Breton, 2004). Although this 'era of personal genomics' (Blow, 2007) can bring about the use of predictive and precision medicine and treatments, such predictions can induce fear in those of us who are told that we hold the genetic markers of a dreaded condition (Ransohoff D. F., 2010). Consequently, genetics can feel like a benefit to health and a source of risk (Nelkin, 2001) and the preoccupation with gene-based predictions is leading to worries that it is giving false hope about the human ability to control risks to human health (Heyman, 2010). In view of the risks and uncertainties, medicine and biomedical science seek to promote and protect the human body as a site of what Giddens (1991) refers to as 'ontological security'. Genetics can be seen as the latest development in the illusion of the ultimate conquest of human disease and the existence of something approaching a perfect state of human health, which Rene Dubos (1959) referred to as the 'Mirage of Health'. For example, recently it has been reported that humans might be able to wipe out a range of hereditary conditions, because scientific research has been used to edit the genes in human embryos 'to repair a common and serious disease-causing mutation, producing apparently healthy embryos…[which] raises the prospect that gene

editing may one day protect babies from a variety of hereditary conditions' (Belluck, 2017). But the mirage that the genetic paradigm offer seems to fails to 'respect the diversity of human embodiment' (Shakespeare, 1999, p. 685), offers no recognition of the rise of alternative and more holistic forms of diagnosis and treatment (McQuaide, 2005) and excludes the role of the environment and context in which illness takes place (Conrad, 1999, p. 240).

Despite the limitations and the inevitable malfunction and death of our bodies we see them as, or expect them to be, almost ceaselessly 'malleable entities' (Shilling, 2003, p. 5). Drawing on Michel Foucault's work, Turner conceives of the human body as a project that is the target of 'institutions of normative coercion' (Turner B. S., 1992). Here Turner reflects on the non-violent coerciveness of institutions that have the commonplace legitimacy and moral authority to involve themselves in projects of the body (Turner B. S., 1992). Key personnel, practitioners and organisations are regarded as having a central role to play in our individual bodies as sites of remedy, renovation, and reconstruction. The human body project depends on others - the medical profession, the pharmacists, the researchers. Thus medicine and biomedical science are central to the human body project. Developments in science and technology have provided humans with the capacity to manage more effectively, to some extent, the deterioration of the human body, which has led to its increasing commodification and the ever-growing desire to get the body 'machine' under control. Technological changes have influenced further our conception of the human body – transformation is an expectation. So although our bodies continue to constrain us (Giddens A. , 1984), scientific developments have enabled greater control over them (Shilling, 2003, p.

36), which in turn has led to increasing expectations that further developments will lead to still more potential for control. Body technologies are developing at a rapid rate and the new technologies of the 21st century have resulted in more readily available and often less invasive measures, in the forms of, for example, health screening e.g. (Bonham, 2013), treatments e.g. (Dolgin, 2011) and transformations e.g. (Ipjian, 2017). However, Anthony Bowen and Arturo Casadevall (2015, p. 11338) point out that 'any link between biomedical innovations and overall life expectancy is controversial' because a range of other factors including 'political stability, food production, hygiene, education, income, transportation, and communication' possibly have greater effects.

Biomedical science and nonhuman animal body 'models'

The practices of medicine and biomedical science take place within social organisations such as universities, research laboratories, businesses, hospitals and clinics, and are conducted by humans who are 'socially recognised as competent practitioners within a division of labour' (Dingwall, 2013, p. 167). In addition to these recognised humans are the millions of nonhuman animals who are entangled involuntarily in biomedical science every year. By biomedical I mean the current paradigm in clinical medicine (that is in medical education, research and practice) (Annandale, 1998) that addresses the human body as a complex machine to which the physician administers treatments for recognised pathologies. Biomedical research most usually takes places within an established 'normal scientific' paradigm. Here I am referring to Thomas S. Kuhn's conceptualisation of 'normal science' as a paradigm that is established on the basis of unquestioned and unchallenged

understandings that are 'predicated on the assumption that the scientific community knows what the world is like' (2012 [1962], p. 5). The normal scientific paradigm in biomedial research accepts, normally without question, the use of nonhuman animals as 'models', that is as resources for use in experimentation (Peggs K. a., 2017). The paradigm of the 'animal model' involves using living, nonhuman animals to extrapolate to possible responses in humans for the benefit of humans (Greek J. S., 2004, p. 15). Nonhuman animals are used in experiments, as well, in the form of 'tissue obtained' from their bodies (Greek J. S., 2004, p. 15). Scientists such as P. Michael Conn and James V. Parker argue that 'virtually every major medical advance of the last century is due, in part, to research with animals' (Conn, 2008, p. 158). A 2011 poll of nearly 1000 biomedical scientists found that more than 90 percent 'agreed that the use of animals in research is essential' (Cressey, 2011). However, many scientists maintain that such experiments are detrimental to humans. For example, Ray Greek and Jean Swingle Greek argue that 'the extrapolation of results from animal models misleads scientists and harms human patients' (Greek, 2002, p. 11). For instance, they refer to 'Transgenic animals... [who] have failed to shed light on human diseases. Why? Because changing one or two genes out of 30,000 will not make a human out of a mouse' (Greek and Greek, 2004, p. 44). What is more, the instrumentalisation of the nonhuman animals who are used in experiments is a problematic human practice that demands an engagement with ethics (Working, 2015). But despite the disputations around ethics and efficacy, millions of nonhuman animals are used every year in such experiments (Working, 2015).

Finding accurate data on the numbers of nonhuman animals who are used in biomedical science is extremely difficult. A conservative estimate puts the total number of living vertebrate nonhuman animals who are used annually in experiments worldwide at 115.3

million (Taylor, 2008, p. 327). Katy Taylor and her colleagues estimate that the United States (US), Japan, China, Australia, France, Canada, United Kingdom (UK), Germany, Taiwan and Brazil use the highest numbers of nonhuman animals, in that order (Taylor, 2008, p. 327). Although the overall figure is based on data for 2005 it remains the only worldwide figure available (e.g. see (Peggs K. , 2015). However, it is an approximation and Taylor et. al. conclude that it 'is still likely to be an underestimate' (Taylor, 2008, p. 327). This is certainly true. Seventy nine percent of countries (including China, Egypt, Iran, India, and Thailand) do not publish statistics and some countries publish only partial figures (Taylor, 2008, p. 327). Moreover, the figures for most countries cover mainly vertebrate nonhuman animals; there are also millions of invertebrates who, like some excluded vertebrates, are not included in the statistics as they are not considered to be 'animals' for legislative purposes (Peggs K. , 2010). For example, the US is at the top of Taylor et al.'s list but the 767,622 nonhuman animal subjects who were reported to have been in experiments in the fiscal year 2015 excludes 'cold-blooded' nonhuman animals, rats, mice, birds, reptiles, amphibians, and nonhuman animals used in agricultural experiments (United, 2016). Rats and mice comprise the overwhelming majority of all laboratory subjects used (Goldberg, 2002). Taylor et al estimate that Australia is the fourth highest user of nonhuman animals in experiments. Over 9.9 million nonhuman animals were reported to have been used in experiments in 2015, which is the highest recorded number since 2007 (Humane, 2016). These figures include 1,412,613 mice and 108,261 rats (Humane, 2016)

Although the statistics, even the underestimates, give an impression of the enormous scale of the harm done, the figures do not offer attention or respect to the experiences of the suffering of the individual nonhuman animals involved. Indeed, quantification can serve to

distance us from understanding the lived experiences of individual nonhuman animal subjects who are used in biomedical experiments (Peggs K. a., 2017). Nonhuman animals who are used in experiments are subjected to 'procedures against their own individual interests, including those that involve the deliberate infliction of suffering, harm, and/or death" (Working, 2015). But what happens in the biomedical experimental laboratory is occluded as most of us are spatially separated from and are denied access to the research facilities in which these experiments take place (Peggs K. , 2012). A central characteristic of the biomedical model is the claim that it is scientifically neutral in its 'rational, objective and value-free' approach to medicine (Annandale, 1998, p. 7). Bernard Rollins recalls 'The slogan that I learned in my science courses in the 1960s, and which is still taught in too many places…that science is value-free in general, and ethics-free in particular' (Rollin, 2007, p. 522). Despite claims of ethics-freedom and value-freedom biomedical science is not based in such 'freedoms' because anthropocentric values and ethical bias frame biomedical experimentation that has sought to advance the human body by garnering, promoting and intensifying the utility of nonhuman animal subjects as tools in the promotion of human health benefits - as expendable implements for human body projects. The human body project entangles within it the living and dead bodies of nonhuman animals. These nonhuman animals are largely occluded as their sole purpose is presumed to lie in how they can assist with the body projects of valued humans. These exploited bodies in the human body project are being made more and more exploitable by scientific and technological developments (Brown, 2001) and by positions that render and entrench the nonhuman animal body as subordinate to the human body and its project. In what remains of this paper I explore what I see as the broad delineation between *positive* and *negative* body projects, between the human-created nonhuman animal negative body projects (where the

intention is to induce suffering, to make bodies ill and often is to kill) that are claimed to be essential to the development of human positive body projects (where the intention is to relieve suffering, to make bodies well and to delay death) (Peggs K. , Forthcoming).

Nonhuman animal body projects and the multispecies body in sociology

One of the consequences of identifying the human body as an unfinished phenomenon that is continuously under surveillance and is to be worked on is that we are left with an 'uncertain body' (Shilling, 2003, p. 3). It is uncertain because it is always in process, because we are mindful of increasing health risks, and because we have become unclear about what constitutes the 'natural' human body. Transplants, implants and cosmetic surgery are just some of the ways in which the 'naturalness' of the human body has come into question (Shilling, 2003, p. 4). Interrogations associated with 'naturalness' are an important element of my discussion here as they can foster consideration of human presumptions about distinctions between bodies and about human capacities to manipulate bodies and distinctions. These presumptions and capacities are fundamental to the human body project and the negative body projects that humans impose upon nonhuman animals.

The imaginary hard line that humans have drawn between themselves and nonhuman animals has enabled humans to instrumentalise nonhuman animals for use in the laboratory and beyond (Derrida, 2008, p. 80). Jacques Derrida argues for the deconstruction of this ontological binary, which encourages a challenge to the ways in which nonhuman animals are being subjected to 'medico-industrial exploitation, overwhelming interventions … [in

their] milieus and reproduction, genetic transplants [and] cloning" (Derrida, 2008, p. 80) (for discussion see (Peggs K. a., 2017). This deconstruction is fundamental to multi-species sociology because, as Arnold Arluke and Clinton Sanders made clear in the mid-1990s, (Arluke A. &., 1996, p. 9), we need to understand nonhuman animals as 'social constructions' which means deconstructing and moving beyond what see as 'innate' in order to understand our entanglements with them. They remark that "Being" an animal in modern societies may be less a matter of biology than it is an issue of human culture and consciousness' (Arluke A. &., 1996, p. 9). But it is only relatively recently that some sociological thinking has been devoted reflecting on and offering a challenge to human assumptions about 'innate', 'natural' differences between humans and all nonhuman animals (for discussion see (Peggs K. , Animals and Sociology, 2012). The social construction of 'natural' nonhuman animal bodies is clear in biomedical experimentation. At around the same time that Arluke and Sanders were making their appeal, Carol J. Adams (1995) was focusing on the construction of the nonhuman animal who is used for experimentation. She observed that the human acceptance of nonhuman animal experiments depends on a contradictory plea to difference and to similarity between human and nonhuman animals. Adams sums up this 'formula for knowledge' in the duplicity 'animals are not like us so we can… animals are like us so we conclude…' (1995, p. 52). This reflects the simultaneous plea to difference, which is used as the moral grounds for permitting nonhuman animal experimentation, and similarity, which is used as the 'applied' grounds for extrapolation to human from a range of experiments that use species of nonhuman animals. Millions of nonhuman animals are forced into negative body projects on these contradictory 'ethical' and 'applied' grounds. Not recognizing the duplicity or even the antagonism, Françoise Barré-Sinoussi and Xavier Montagutelli (2015) argue that 'Animal models must be constantly

improved to be more reliable and informative. Likewise, animal protection requires permanent consideration'. Rather than antagonistic they contend that this 'must be anchored in high-quality science' (Barré-Sinoussi, 2015). The exploited bodies of the human body project are being made more and more exploitable by scientific and technological developments (Brown, 2001) and in order to explore these entangled projects I reflect on two linked elements of the negative nonhuman animal body projects - domesecration (Nibert D. , 2013) and genetic modification.

Domesecrated nonhuman animal bodies

Nonhuman animals who are used in experiments are converted to and conceptualised as research 'tools'. This modification leads to a transformation in perceptions among scientists from seeing the nonhuman animals 'as similar to those in the wild, to seeing them as tools of the trade' (Birke L. A., 2007, p. 21). David Nibert speaks to this process with his notion of 'domesecration', which points to the 'systemic practice of violence in which social animals are enslaved and biologically manipulated, resulting in their objectification, subordination, and oppression.' (Nibert D. , 2013, p. 12). In the laboratory, species of nonhuman animals who might be seen as, for example, free living 'wildlife' (e.g. rats and mice) or as companion nonhuman animals (e.g., dogs and cats) are transformed 'into 'analytic' objects of technical investigation' (Lynch, 1988, p. 266). They become viewed as 'sacrifices' (Birke L. A., 2007) (Lynch, 1988) who are transformed into data. Because rats and mice who are used in laboratories are less likely to be viewed as companions outside the laboratory they are usually considered to be more acceptable 'tools' (Birke L. A., 2007). 'Domesticated' nonhuman animals have been heralded as 'unique models for biomedical

research due to their long history (thousands of years) of strong phenotypic selection' (Andersson, 2016, p. 1) and rats are thought to be the first species of mammal to be 'domesticated' for scientific purposes (Homberg, 2017).

'Domestication' is a term that is often used to describe the process that transforms nonhuman animals who have been, for example, selectively bred by humans for specific purposes. But Nerissa Russell (2002) notes that 'domestication' is very difficult to define. In an attempt to explain the term she proposes that it involves two related fundamental elements; i) the control of the movement and the breeding of nonhuman animals, which leads to ii) 'morphological and behavioural changes in that population's (Russell, 2002, pp. 287, 286). Although some writers suggest that 'domestication' involves the production of a symbiotic relationship of equal partners that benefits both humans and nonhuman animals (e.g. see Terry P. O'Connor (O'Connor, 1997) this position is anthropocentric and does not recognise what is fundamental to 'domestication', that is the human exploitation of nonhuman animals. As Pierre Ducos observes, 'domestication' requires nonhuman animals to be 'integrated as objects into the socioeconomic organization of the human group, in the sense that, while living, those animals are objects for ownership, inheritance, exchange, trade, etc.' (1978, p. 54). Nibert's reconceptualization of 'domestication' as 'domesecration' makes clearer the exploitation and the 'systemic practice of violence' (2013, p. 12) that it involves, which leads to the suffering of nonhuman animals in laboratories and beyond. Once in the laboratory, nonhuman animals can look very different to our conceptualisations of them (e.g. a mouse with a human ear), can be genetically very different to those who are free-living (e.g. genetically modified nonhuman animals who are predisposed to human diseases) and are treated differently from how we expect them to be treated (e.g. having

their bones broken, being burned, and being subject to a range of human illnesses and diseases) (Peggs K. , Forthcoming).

The nonhuman animals who are used in biomedical experiments are considered by scientists to be intrinsically suitable for the role that scientists have given them and not only suitable, they are deliberately 'designed' for the purpose (Peggs K. a., In Press). For example, marmosets are deemed by researchers to be suitable for biomedical experiments because of their 'small size, ease of handling, and unique biological characteristics' (Yun, 2015, p. 156). Moreover, researchers argue, their utility to humans is increased because 'Monkeys have many similarities to humans in terms of developmental processes, brain anatomy/function, and social behaviors' and 'in particular, the use of the marmoset monkey requires less ethical justification than the larger "Old World monkeys"' (Yun, 2015, p. 157). Recall the duplicitous 'formula for knowledge' detailed by Adams (1995). One area of biomedical research in which marmosets are used is the effort to alleviate human Parkinson's disease. Parkinson's disease affects mobility and muscle control and is a 'progressive neurodegenerative disease that has no cure' (Meredith, 2011, p. 19). In order to test new human treatments researchers induce symptoms in marmosets that are similar to those of human Parkinson's disease (Yun, 2015, p. 162). This is done either through genetic modification or by means of the administration of neurotoxins such as MPTP (Yun, 2015, p. 157). Gloria E. Meredith and David J. Rademacher explain that the neurotoxin MPTP causes permanent symptoms of Parkinson's disease by killing dopaminergic neurons in the brain (see (Meredith, 2011). Jun-Won Yun and colleagues report that MPTP 'has led to the development of valuable mammalian models, including sheep, dogs, guinea pigs,

cats, mice, rats, and monkeys, for research on the pathophysiology, etiology, and pathogenesis of PD [Parkinson's disease]' (Yun, 2015, p. 157). They report that the use of MPTP offers 'the greatest similarity to the clinical features of human PD disease such as tremors, rigidity, akinesia, and postural instability' but, they continue, 'the animals with severe symptoms following the systemic or local administration of the neurotoxins need the (sic) intensive care with artificial feedings' (Yun, 2015, p. 162). Nevertheless, they recommend that 'In order to cure Parkinsonian symptoms, highly reproducible animal models of PD should be developed to address all PD-related questions including pathological changes in the brain' (Yun, 2015, p. 162). Parkinson's disease, like many other human conditions, can also be induced genetically in nonhuman animals.

Genetic alteration of nonhuman animal bodies

Genetic alteration has become a central component of the transformation of nonhuman animals into laboratory 'tools'. 'Genetically altered' is one term among a number that are used to label nonhuman animals who have been changed genetically - other terms include transgenic, genetically modified, genetically manipulated and genetically engineered (Ormandy, 2011). These terms in some ways reflect the changes in technology that have moved from transgenesis, which involves 'the transfer of genetic material from one organism to another' to more recent procedures that have replaced transgenesis with procedures that involve 'the deletion of genes, or the manipulation of genes already present' (Ormandy, 2011, p. 544). Technologies for genetic alterations have enabled corporations (such as Du Pont) to breed and sell nonhuman animals (such as the mouse

'patented' as 'OncoMouse') as 'superobjects' who are 'designed' to meet the needs of scientists and other researchers (Peggs K. , 2012). The first transgenic mice were developed in 1982 and it was in the 1960s, Karen Rader (2004, p. 13) observes, that 'standardized' mice (who had been 're-engineered by humans' by means of inbreeding to control their genetic makeup) became 'laboratory fixtures'. Phil Macnaghten's 'consequentialist approach' to the history of technological developments makes clear 'that new techniques of genetic modification should be properly understood as continuous with older patterns of selective breeding' (2004, p. 536). Thus we can see the call by Yun and colleagues (2015) for the development of 'highly reproducible animal models' (discussed above) as a manifestation of the human manipulation, utilisation and commodification of nonhuman animals that has endured for centuries.

In the search for cures for humans, nonhuman animals are genetically altered in their millions. Some genetic alterations have no visible effect (Ormandy, 2011, p. 544) while others can cause devastating visible defects, such as mice who are born with no limbs, no eyes, no noses, no lungs, no fronts to their heads, no brains, no skulls, with their internal tissues exposed (Turgeon B, 2009). The use of genetically alternated nonhuman animals is claimed to be a triumph. For example, in the discovery of pharmaceuticals 'knockout' mice (that is those who have been stripped of a gene) have been described as 'invaluable components in conjunction with transgenic lines of mice as a means of generating "humanized" mouse models' (Doyle, 2012). 'Knockout' nonhuman animals are also used for cancer research including rats who are stripped of a gene that suppresses human forms of breast cancer (Pilcher, 2003), and mice who have been bioengineered to develop melanoma

(McKinney, 2011). Additionally, genetic alteration is also used in search of treatments for a range of human diseases. Genetically altered nonhuman animals are used in the search for a cure for sepsis. Sepsis is a complex syndrome (Pötschke C, 2013) that refers to an exaggerated systemic response to infections that leads to septic shock (Van Oosten, 2001, p. 8820). The nonhuman animals subjects who are most used in these experiments are mice (Fink, 2014). Mice are 'most popular' for this research, writes Mitchell P. Fink, because they are 'very small', they 'pose little or no danger to laboratory personnel', they are 'widely available from suppliers', are 'relatively inexpensive', and they are 'not regarded as companion animals which means the studies 'may be regarded as being more ethical than are studies that enroll cats, dogs, horses, or non-human primates as research subjects' (Fink, 2014, p. 148). Unlike humans, mice are highly resistant to the toxic effects of bacterial lipopolysaccharide (LPS), the primary cause of bacterial sepsis, and thus they must be given enormous doses, 'roughly 40-fold difference in the dose of LPS that is required to produce toxicity or death [in] human beings' (Fink, 2014, p. 148). These doses generate symptoms like those in humans, 'most notably overwhelming meningococcemia' (Fink, 2014). Sepsis is associated with an 'astoundingly high' morbidity and mortality rate in humans (Pötschke C, 2013). Jean A, Nemzek and colleagues note that that 'Several factors appear to put the field of sepsis research at odds with key tenets of animal welfare'….including that 'sepsis studies often do not use analgesics' (2008, p. 125).

Concerns the 'welfare' of nonhuman animals who are used in biomedical research has led some researchers to experiment with gene-based technology with a view to developing

nonhuman animals in which 'The pain involved in the experiment would be minimized to the point of non-existent' (Gardner, 2008, p. 146). Recall Barré-Sinoussi and Montagutelli's (2015) argument that 'reliable and informative' nonhuman animal 'models' must go hand in hand 'animal protection'. Renee M. Gardner and Alan M. Goldberg report that advances in neuroscience have meant that there is increased understanding of the body's sensory nervous system's response to harmful stimuli, including the detection of a single gene mutation…that leads to complete insensitivity to pain in humans (Gardner, 2008, p. 145). In that same piece they noted that 'Work on knock-out mice is already underway' (Gardner, 2008, p. 145). In 2014, Jacinthe Gringras and colleagues reported that they had bioengineered mice who 'recapitulate the phenotype of human congenital indifference to pain' (Gingras J, 2014). In order to make this discovery they compared the 'knockout' mice with other mice using, for example, a 'hot plate', 'tail clip' and the toxic substance 'formalin' to test 'sensitivity or sensitivity thresholds to thermal, mechanical, chemical-induced, and inflammation-induced pain' (Gingras J, 2014). They concluded that 'Knockouts were anatomically normal, reached adulthood, and had phenotype wholly analogous to human congenital indifference to pain' (Gingras J, 2014). The technological 'solution' to the negative body projects that humans impose on nonhuman animals offered by these scientists is to agonise nonhuman animals in order to develop 'pain-free' cousins who will not suffer when they are used in laboratories (Peggs K. a., In Press)

Sociology of the Multispecies Body: Concluding Remarks

Human and nonhuman animal bodies are entangled in a multitude of ways. They are entangled in the production of food, in the manufacture of clothing, in the generation of entertainment, in the doing of science. I have argued for a multi-species sociology of the body that recognises these entanglements. Although the sociology of the body has largely centred on the human body the study is well-equipped to include in its remit the subjugated bodies of nonhuman animals that have become negative body projects, utilised, suffering and expendable in the cause of the positive human body projects of health. Sociology has a history of engaging with and criticising assessments of the elemental, utilised as hierarchical, differences and similarities among humans and it is well-placed to apply these critiques to similar assumptions about distinctions between all animals, humans and nonhuman (Peggs K. , 2012). In this paper I have focussed on biomedical animal experiments because such research is considered to have a more 'ethical' purpose and because there is more public acceptance of experiments that use nonhuman animals if they have human health objectives (Peggs, 2015). In order to make this claim biomedical science takes the human 'animal' binary hierarchical distinction for granted but, as Dingwall et al argue in their discussion of medicine and biomedical science, we cannot 'leave it all to biomedical science' (2013, p. 173) because sociologists have a role to play in reflecting on what goes on in these social institutions. Ultimately, by exposing the entanglements of human and nonhuman animal bodies and by reiterating the oppression of these entanglements I hope to enhance a sociology that is *for* nonhuman animals (Peggs K. , 2013), which is necessarily grounded in a multi-species sociology.

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