‘Biosensors in Fluffy Coats’:
Interspecies Relationships and Knowledge Production at the Nexus of Dog-Training and Scientific Research

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I, Katrina Holland, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Abstract

This thesis explores human–dog relations and knowledge production at the nexus of dog-training and scientific research, when dogs are trained to detect the odour of human disease via biological samples. Based on twelve months of fieldwork at two dog-training and research organisations, in the UK and USA, this thesis explores the practices through which bio-detection dogs are produced and how knowledge is produced about, and with, them.

Whilst a growing body of scholarship exists across and beyond the social sciences, on both human–animal relations and the role of animals in laboratory practices, the relatively recent emergence of research practices involving bio-detection dogs illustrates a novel mode of incorporating animals into scientific practice that has, until now, evaded theoretical analysis. By focusing on this practice, this thesis contributes original insights to the literature regarding both multispecies relationships and science studies.

Consistent with the intellectual commitment of multispecies ethnographers to bring nonhuman beings into the ethnographic foreground, the analysis presented in this thesis pays attention not only to the dog-trainers' perceptions of the dogs, nor solely to *what* the dogs might be (i.e., as a species) but also to what the dogs are observed as doing themselves.

Developing an analysis of how interconnectedness between human and dog is shaped among my informants, this thesis explores how the boundary between human and animal, that is often assumed to be rigid in sites of scientific practice, is called into question through the engagements between humans and dogs in the realm of bio-detection. The notion of 'response-ability' (Haraway 2008) emerges as an important analytic for understanding the practices and processes of bio-detection dog-training and research, as the capacity of both partners to respond and be affected by the other is revealed to be fundamental to both the training and research practices.

Impact Statement

Despite their relatively high prevalence, certain forms of cancer (e.g., prostate or ovarian cancer) and other diseases remain difficult and dangerous to diagnose. This project explores human–dog relationships and the production of scientific knowledge where dogs are trained to detect the odour of human diseases including cancer. This project also explores the conditions under which this relatively recent practice has developed. The impact of this thesis can be assessed both within and beyond academia.

Inside academia

Within the discipline of anthropology, this thesis contributes particularly to scholarship regarding the 'animal turn', with the work presented complementing research that has illustrated the entanglement of human lives with the lives and deaths of myriad other species. This research also adds to the body of social scientific literature exploring the place of animals in spaces of scientific inquiry, by considering a case study previously unexplored from a social science perspective. Thus, this work contributes original insights to interdisciplinary conversations—among the humanities, social sciences and sciences—about the spaces and practices of animal-dependent research. The insights developed in this thesis also benefit the nonhuman animals in my research by promoting discussion about the ways in which they are enrolled in research activities and how more responsible practices in science might be facilitated.

I have presented papers based on this research at several interdisciplinary academic conferences including the British Animal Studies Network meeting 'Working with Animals' in October 2017 and more recently, a conference entitled 'Rendering the Invisible Visible' hosted by artists at University College London in May 2018.

Outside academia

Outside the academic arena, this thesis provokes reflections on our contemporary relationships with dogs and our responsibility towards nonhuman animals more broadly. Through the lens of bio-detection dogs, this project helps the wider public to consider the diverse ways in which people form associations with nonhuman animals in order to improve human health.

This impact has been advanced through public engagement activities. Most notably, I contributed stories and objects from my research to the exhibition 'The Museum

of Ordinary Animals' which ran from 21st September to 22nd December 2017 at the Grant Museum of Zoology, UCL. This exhibition aimed to put 'ordinary animals' at the center and explored their contributions to human culture and medicine. The total number of visitors to the exhibition was 15,850. Furthermore, as part of the exhibition's associated events programme, I spoke on the panel of a public discussion titled 'Let's Talk About Dogs'.

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Acknowledgments

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In memory of my father, my biggest champion.

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Chapter 1. Introduction

It is the bi-monthly 'demonstration-day' at the headquarters of Medical Detection Dogs: a British charity that conducts research around the dog's ability to detect the odour of human diseases such as cancer. Alongside a group of visitors sat on white plastic chairs in the informal viewing gallery, I watch through the transparent glass wall into the training room as Sadie, a black Labrador, and her trainer Ed, an Englishman in his thirties, demonstrate what these dogs are trained to do: detect the odour of human disease. One of the bio-detection trainers who is watching with us explains that Sadie is a prostate cancer detection dog, trained to sit at cancerous samples of urine, presented in plastic pots on a carousel structure.

Inside the training room, Kelly raises three of her fingers to let us know in which position on the carousel the target odour has been placed. Ed enters the training room with Sadie at his side. The pair make their way to their starting point, around a metre back from the first position. Ed stands behind a one-way-screen, with Sadie to his left side. Sadie sits for a few moments before Ed points his hand to the first position and tells Sadie to search. She sniffs the first and then second samples, neither prompting an alert response. With her nose over the pot containing the third sample, she immediately bends her hind legs and adjusts herself into a sitting position. Sadie's neat indication prompts applause from the visitors and comments of "Wow!" and "So clever!" As they clap, Ed walks over to where Sadie is sat and feeds her some kibble (dried dog food) treats. Ed and Sadie then leave the room whilst Kelly switches the position of the target. The group watch Sadie search and indicate in this way four more times.

This thesis focuses on the training and research practices involving 'bio-detection' dogs like Sadie, and the humans who train them and interpret the individual dog's behaviour during their search activities. Bio-detection dogs are trained to detect the particular odour of volatile organic compounds (VOCs) originating in disease cells (e.g., prostate cancer, Parkinson's disease) and excreted in human biological substances (e.g., urine, sweat, and breath). A positive detection is communicated to the dog's handler via a trained 'alert' response, usually in the form of the dog sitting next to the positive sample. Conversely, the ideal bio-detection dog ought to ignore non-cancer-specific odours (e.g., odours associated with bleeding and inflammation that are common effects of a variety of other health conditions). The training methods used to produce these dogs prioritize a positive

reinforcement approach, whereby the dog is rewarded with something considered to be meaningful to the individual dog (usually food) when he makes a correct alert in response to the salient odor.

Despite their relatively high prevalence, certain forms of cancer and other diseases remain difficult and dangerous to diagnose. For instance, the Prostate Specific Antigen blood test—the current gold standard—used to diagnose prostate cancer has false-positive rates of up to 75% (Slatkoff et al. 2011). In addition, the more invasive test of needle biopsies also used to diagnose prostate cancer can have severe side effects associated with the risk of the needle contaminating tissue with bacteria and cancer cells. Another of the diseases bio-detection dogs are being trained to detect, Parkinson's, currently lacks a diagnostic test, meaning that many sufferers unknowingly experience the disease for many years before their symptoms become progressively more detrimental. Thus, Medical Detection Dogs are responding to a need to develop accurate, non-invasive tests for the early diagnosis of cancers and other diseases. With around two hundred million olfactory receptors, compared to the average human's five million, dogs are obvious candidates for this kind of work.

This thesis focuses on the work of two organisations that produce such bio-detection dogs. Currently, bio-detection dogs are not utilized operationally in the diagnostic process of any disease. Instead, at the time of this fieldwork being undertaken, the work is exclusively focused towards conducting proof-of-principle studies under double-blind conditions to generate a 'scientific' evidence-base of these dogs' detection abilities. Thus, alongside the cultivation of bio-detection dogs, a second product that is generated by these organisations is the data used to inform scientific knowledge. A primary aim of both organisations is to explore the potential of dogs as diagnostic tools through the training, testing and peer-reviewed publication of their work. As such, they hope to provide the scientific community with quantifiable evidence regarding the dog's ability to detect the odour of human disease.

Although the disease-detection capacities of these dogs are not currently being employed for diagnostic purposes in practice, through the production of bio-detection dogs—and that of the knowledge about their potential—both organisations imagine their work will improve diagnosis for future patients, or potential patients, hoping to make the diagnostic process both less invasive and more accurate. How this goal is conceptualized as being accomplished varies slightly in accordance with the specificities of the different

conditions and how they present or are manifest. For instance, my dog-trainer informants speculated that malaria-detection dogs might in the future be utilized at entry ports to identify travelers carrying malaria to prevent the spread of disease across borders and ensure potential patients receive antimalarial treatment. Meanwhile, dogs trained to detect cancer are not themselves anticipated to become a feature of the clinic at the clinician's disposal. Instead, through collaborations with physicists and chemists, the dog's skills are being investigated in an effort to identify the chemical composition of such odours and develop more sophisticated 'electronic-noses' that effectively mimic the dog's nose; imagined diagnostic tools of the future that, as envisaged, will enable greater efficiency than the dog.

It is thus possible to consider the work of these organisations as combining two fundamental dimensions of practice: (1) training dogs and (2) scientific investigation, or testing. Observations detailed in this thesis highlight a tension in the structure of relations between human and dog that are fashioned in order to achieve both of these related goals. In particular, the shape of human–dog engagement is found to oscillate in this work in order to accommodate both the needs of trainers working with dogs using methods of positive reinforcement, and the aims of scientific investigation.

When working with the dogs, the trainers perceive the animals as beings who 'look back' (Haraway 2008, 21) to their trainer, read his body language and adjust their own behavior in response. During the earlier stages of training, such intersubjectivity between the partners is actively encouraged and an emphasis is placed on the individual handler-dog relationship as a fundamental element in promoting a dog's desire to participate in the work. However, in order to conduct scientific studies investigating the reliability of the dog as a diagnostic tool, there is a requirement for such cross-species intersubjectivity to be productively managed—to guarantee that a dog's search behavior, or diagnostic reliability, is a function of the odor stimulus alone and not dependent on any unconscious cues from his handler.

Ideally then, the ideal bio-detection dog, under scientific investigation, would be reliable working under the guidance of an interchangeable handler. However, the reliability of the dog's detection is understood to be dependent on both the dog's olfactory sensitivity *and* the interpretation of the individual dog's behavior by his handler. Fundamentally, the data yielded is generated through a handler's interpretation of a dog's behavioral response to an odor stimulus. Thus, throughout the training and testing phases

of their work, bio-detection dogs are paired with a specific trainer who, it is understood, will gradually develop a more refined ability to read that individual dog's nuances. As such, the organisations can be understood as producing interspecies detection teams, comprised of human and dog whose engagement is characterized by a tension between moments of attachment and detachment.

Focusing predominantly on the training of bio-detection dogs in this thesis affords a set of practices through which to ethnographically explore themes of interspecies relating, nonhuman agency, responsibility, and knowledge production.

i. The Animal Turn

From 'Thinking With' to 'Living With': The Emergence of Multispecies Ethnography

> It is extremely important that we recognize the involvement of nonhumans in the creation of cultures (human or otherwise), that we understand that they are not only 'good to think with' but also crucially partners in the making of our world. (Birke 2011, xix)

The discipline of anthropology has been subject to a long tradition in which human life has been considered apart from, and above, the lives of nonhuman animals. Indeed, by definition, anthropology is the study of *man*-kind,[1] and the roots of the subject are entrenched in western science, religion, and moral philosophy that has, since antiquity, insisted on rigid lines purported to separate man from animal and, correspondingly, culture from nature. This is not to deny that animals have long featured in important works of anthropological literature, but in the instances where early-mid twentieth-century anthropologists referred to nonhuman animals in their writing, those animals were traditionally considered 'on the margins of anthropology—as part of the landscape, as food for humans, as symbols' (Kirksey and Helmreich 2010, 545).

For example, in his now infamous essay on the Balinese cockfight, Clifford Geertz (1973) suggests that the cocks represent the men themselves and express the tensions and conflicts among them. For Geertz, the human–animal relationships he observed were not

[1] Anthrōpos is the Greek word for 'human being,' and the suffix -logy means 'the study of.'

important in their own right. Rather, the cockfight offered a window through which to observe and analyse Balinese culture. As suggested in Claude Levi-Strauss' (1963, 89) much cited remark, that animals are 'good to think' with, animals were classically perceived as simple vehicles with which to understand a particular social group or process (for examples, see Evans-Pritchard 1950; Geertz 1973; Levi-Strauss 1963). With an anthropocentric focus that reproduced a stark human/animal binary, human–animal interactions were thus documented from a solely human perspective throughout the twentieth century.

Particularly over the last two decades, as part of the 'animal turn' gaining traction in the humanities and social sciences, anthropologists have begun to reconsider the way in which the human is theorized in relation to other animals, and subsequently, how the animals themselves are considered. Adrian Franklin (1999, 3) suggests that a radical shift has occurred in late modern society whereby 'the categorical boundary between humans and animals, so fiercely defended as a tenet of modernity, has been seriously challenged, if not dismantled in places'. Today, within the discipline, it is increasingly recognized that the human experience is not somehow abstracted and distinct from other forms of life, but fundamentally constituted through relations with other species. The dominant discourse that is challenged by such an approach is identified by Donna Haraway (2008, 11) as 'human exceptionalism', or 'the premise that humanity alone is not a spatial and temporal web of interspecies dependencies' (Ibid.). In its place, has emerged an approach to understanding interspecies connections where animals and indeed plants are no longer mere 'windows and mirrors' (Mullin 1999) into and of symbolic inquiry. Not an exclusively zoological concern, anthropologists have revealed how plants (Archambault 2016) and other living agents, such as the herpes virus (Lowe and Münster 2016), are fundamentally entangled with human life. These kinds of inquiries, in the 'contact zone' (Haraway 2008) between human and nonhuman, have come to be known under the rubric 'multispecies ethnography' (Kirksey and Helmreich 2010). Despite studying the engagement of humans with a diversity of other living things and at varying scales, from mushrooms (Tsing 2009; 2015) to entire forests (Kohn 2013), multispecies ethnographers are united in their attempt to 'bring the animal in' to their work, de-centering the assumed centrality of the human and paying attention to the fundamental role of nonhuman animals in shaping society.

Particularly influential for this thesis is Haraway's (2008) insistence on the importance of animals as not merely vehicles 'to think' with (Levi-Strauss 1963), but as agents 'to live with'. For Haraway, this 'living with' is articulated through her notion of 'companion species' (2003) which she illustrates with a focus on the relational practice of agility training which she is herself a participant in. Though she does focus on dogs in a great deal of her work, her decision to eschew 'animal' for 'species' in this term indicates an acknowledgment that her arguments extend to the many species engaged with human life that do not necessarily fall inside the animal category (e.g., bacteria). Through her notion of companion species, Haraway argues for the recognition that, 'We make each other up, in the flesh. Significantly other to each other, in specific difference, we signify in the flesh a nasty developmental infection called love' (Ibid., 2-3). At stake is thus a challenge towards the supposedly fixed categorical boundaries of nature and culture that separate human and other animals, as well as a renewed understanding of what it is to be an agent in the world. Considering the world as comprised of meetings between companion species, 'reaching into each other' (Ibid., 6), Haraway considers beings—human or nonhuman—as subjects that constitute each other and themselves 'through their 'prehensions' or 'graspings' (Ibid.). In short, for Haraway, 'Beings do not preexist their relatings' (Ibid.).

The development of the animal turn, with its fundamental concerns for the entanglements of human and nonhuman lives, has been remarkably rapid within anthropology and is linked to a growing academic interest surrounding the *Anthropocene*: the term used to delineate the present geological epoch, in which human activity is significantly impacting global landscapes and climates.[2] Described by Eduardo Kohn (2015) as 'an epoch in which human and nonhuman kinds and futures have become so increasingly entangled that ethical and political problems can no longer be treated as exclusively human problems', many scholars engaged in work centered around the anthropocene call for a move away from the ideology that humans are detached from ecosystems and the animals within them and a move toward an understanding of human, animal, plant, and environmental system as inherently symbiotic (e.g., Colombi 2009; Fuentes 2010; Vitebsky 2005). The increasing recognition of human connectedness with other forms of life is consequentially

[2] At the 2014 American Anthropological Association conference, the term *Anthropocene* featured in 64 abstract or paper or panel titles, compared with zero the previous year.

prompting a reconsideration of the place of humans in the world; arguably, an essential project to ensuring the survival of the planet's ecosystems. Thus, the animal turn can be understood, at least in part, as a response to the discipline's heightened engagement with the social, cultural, economic, and political issues surrounding climate change.

In this thesis, while I hope to bring the dog in, I emphasize that 'bringing in' the animal does not necessarily mean 'putting out' the human (Hurn 2012, 219). Thus, while making space for canine-centered perspectives in my ethnography and analysis, I remain committed to the disciplinary orientation of anthropology (i.e., the human) by considering the dog's perspectives and actions predominantly in their engagement with the human trainers with whom they work alongside. This is in keeping with the theoretical framework with which I approach this project: an approach that acknowledges that human life is constituted not in opposition to, or apart from, but *through relations with* animal others (Lestel and Taylor 2013, 183).

The Affective Turn

Inspired by the rise in multispecies ethnography as outlined above, this thesis is informed by a conceptual framework that places emphasis on multispecies mutuality, becoming, and entanglement. In recent years, the 'affective turn' in the humanities and social sciences has helped to highlight these aspects of more-than-human relations, as they relate to the capacity of beings of human and nonhuman kind alike 'to affect and be affected' (Massumi 2015): a capacity that emerges through particular encounters (Stewart 2007). Central to much of the social scientific literature on affect have been the works of Gilles Deleuze and Félix Guattari (2004) who argue that 'we know nothing about a body until we know what it can do, in other words what its affects are, how they can or cannot enter into composition with other affects, with the affects of another body' (Ibid., 284).

While affect theorists, largely influenced by Baruch Spinoza's *Ethics* (1992) often through Deleuze (1988), offer diverse understandings of affect, many share some common assumptions noted by historian Ruth Leys (2011, 437) in her assertion that, 'affects are 'inhuman', 'pre-subjective', 'visceral' forces and intensities that influence our thinking and judgments but are separate from these…the affects must be non-cognitive, corporeal processes or states'. Affect is thus pre-emotional with the consequence that one may be affected yet be unable to explain why or put into words the affect experienced. Nevertheless, these are considered simultaneously mundane and formative everyday

experiences (Stewart 2007). In addition, affect is widely considered *not* to be located within the interiority of a subject. Rather, 'intensity', to use Brian Massumi's (2002, 25) words, 'is embodied…at its interface with things'.

An emphasis on affect offers anthropologists novel ways to observe and analyse their subjects. For instance, it provides a challenge to the notion of the self-contained individual (Brennan 2004) and can help anthropologists conceptualize beings in modes that are more permeable than traditional categories might allow. Especially for researchers engaged in multispecies work, with beings who do not share a verbal language, affect is particularly useful with regards to the focus on the senses it can afford (Hayward 2010).

My own understanding of affect follows, in particular, its use by Vinciane Despret (2004; 2013) and Bruno Latour (2004) who both employ affect as a verb, highlighting affective encounters as active processes through corporeal relations. Juno Parreñas (2012, 674) is also inspired by these scholars and offers a succinct definition of affect as 'a dynamic process occurring at the interface of all kinds of bodies'.

Despret's (2004) work in particular has been formative in my engagement with affect theory. Exploring the relationships between scientists and the animals of their study, Despret claims that in a 'practice of domestication' (Ibid., 122) affect comes to produce the nonhuman animals and people who encounter each other. Thus, for Despret, in an argument similar to that made by Haraway (2003), it is through their affective relating that each subject is constituted. What emerges as central to affective encounters, in the work of both Despret (2004) and Latour (2004), are the experiencing, physical bodies of *all* kinds.

Latour (2004) is also interested in how bodies engage with the world and are transformed in the process. As he notes, 'to have a body is to learn to be affected' (Ibid., 205). He uses the example of the practice of training 'noses' within the perfume industry, describing and analyzing how noses are trained to discriminate the subtle differences of odours using odour kits. Through the systematic presentation of subtly contrasting odours, Latour notes that the trainer renders his inattentive pupils attentive to increasingly subtle levels of differences in the chemicals. In Latour's words, 'He has taught them to be affected' (Ibid., 207).

Response-able Relations

The recognition—implicit to both the animal and affective turns—that multiple beings of diverse species are in the process of becoming in their meetings with others, has prompted Haraway (2008, 71) to suggest that multispecies relationships demand 'response-able' relationships. For Haraway, response-ability is defined as 'a relationship crafted in intra-action through which entities, subjects and objects, come into being' (Ibid.). According to her, response-ability is the obligation to develop one's competency in sensing and attending to the needs of the other, that follows an acknowledgment of the entangled subjectivities and possibility for shared pain and mortality of humans and animals alike (Ibid., 83). Crucially, she insists that response-ability is not an obligation exclusive to humans but one that is required of nonhumans too: 'animals as workers in labs, animals in all their worlds, are response-able in the same sense as people are' (Ibid., 71).

Haraway's concept of 'response-ability' has been particularly helpful for scholars attempting to understand how scientists engage with the animals of their study, with a specific focus directed towards the ethical aspects of scientific practice (e.g., Davies 2012; Despret 2013; Greenhough and Roe 2011). Building on Haraway, Beth Greenhough and Emma Roe (2011) argue that response-able relations can be enabled, in encounters between scientists and animal subjects in scientific research, when scientists consider the animals' intention towards them by embodying a heightened attentiveness to bodily responses, or 'somatic sensibilities'.

In this thesis, I will consider how an exploration of response-ability can help theorize relations between the humans and dogs involved in bio-detection research. Considering response-ability, in this case, as an obligation between beings of different kinds, I will pay attention to how the dogs themselves might be understood as response-able in their relations with their humans, asking whether and how the conditions and spaces of training and research either enable or preclude the possibility for the dogs to become beings who are themselves able to respond, and beings to whom it is possible for the humans to respond to. Thus, aligned with Tim Ingold's approach (2013, 8), proposed in his critique of human exceptionalism, I attempt to offer an understanding of both the dogs and humans at my field sites that goes beyond what they *are* (i.e., as a species), to consider what they *do* as individuals and how they constitute each other.

The Rise of Pet-Keeping and Retheorizing Kinship

Studies of human-animal relationships have contributed to some of anthropology's foundational topics, including kinship. One of the most influential anthropologists to contribute to the study of kinship, Marilyn Strathern (1992) has argued that emergent reproductive technologies, such as in vitro fertilization, have reshaped contemporary ideas concerning kinship and nature. In particular, Strathern notes that ideas of kin and connection are becoming increasingly distinct from relationships of blood or direct descent. Referring in particular to the United Kingdom, she also notes a growing emphasis on individualism and the disintegration of extended families. A recent body of literature has linked ideas about kinship with human–animal relationships, with many scholars observing that the close affinities between humans and pet animals are commonly understood in terms of kinship, with pets deeply embedded in family relations (e.g., Charles and Davies 2008; Hansen 2013).

Whilst several studies have found humans to identify their pets as family members (Beck & Katcher 1983; Charles 2014; Franklin 2006; Harris 2011), it is important to note that this does not necessarily suggest a straightforward equivalence (Charles 2014). Although dogs are often incorporated into families as dependents for whom adults are responsible in a way akin to children, many of the dog owners surveyed emphasized that their dogs are prized for their dog-ness (Ibid.). Nevertheless, this expansion of the kinship category to include nonhumans, specifically pet animals, is notable and is associated with a transformation in human–animal relations across European and American contexts over the last century.[3] Certainly, with the rise of pet-keeping in the UK and USA since the

[3] Despite the overt displays of affection people show toward their pet dogs and the wealth of resources bestowed upon them, particularly within Euro-American contexts, just two centuries ago the position occupied by dogs in British culture, for instance, was very different (Ritvo 1987; Thomas 1983; Howell 2015). While some early examples of affective relationships between humans and their canine companions certainly do exist, albeit predominantly anecdotally or fictionally (for instance, Chaucer's fourteenth century *Canterbury Tales*), these occurred principally among people of privileged financial status and rank (Thomas 1983). Indeed, up until the early nineteenth century many Britons still enjoyed the 'sport' of dog fighting (Ritvo 1987). Throughout the Victorian age, however, pet keeping was on the rise and Philip Howell (2015) explores this trend, noting that 'the place of the dog in British society was a "live" question' (3), as the dog was gradually moved out of public space and into its now familiar place at the center of the middle-class home. Howell explains that this redefinition of the dog's place was not without complications however. Rather, it was 'proposed, debated, challenged, confronted—and

Victorian era (Fudge 2008), there have been shifts in attitudes towards animals (e.g., Grier 2006; Ritvo 1987; Thomas 1984; Howell 2015). These transformations in human–animal relations have been associated with a shift in the basis of human–animal relations from *function* to *affect* (Berger 2009; Thomas 1984). James Serpell (2005, 131) notes, human–pet relationships 'are based primarily on the transfer or exchange of social rather than economic or utilitarian provisions'. In addition to their being without a 'proper' function, and thus distinct from animals bred for food or other utilitarian purposes, pets are further distinguishable by virtue of living inside the home and by being named by their humans. The naming process, a ubiquitous feature of human societies that transforms 'anybodies' into 'somebodies' (Geertz, 1973, 363), is a means of individualization that sets pets apart from most other animals. If, as Alan Beck and Aaron Katcher (1996 [1983], 11) point out, having a name is considered 'the essence of being an individual and being a person' it follows that extending the practice of naming to nonhuman animals asserts the animal's individuality and personhood. For animals, names arguably provide 'the vehicle for crossing boundaries' (Bodenhorn and vom Bruck 2009, 4) between the categories of human and nonhuman, enabling them to be considered as subjects within human society.

The rise in pet keeping has been theorized in various ways. One suggestion is that it is a response to ontological insecurity (Franklin 1999): an argument based on the notion that 'relationships with animals can be experienced as providing more stability and consistency than those with human family members' (Charles 2014, 12). Its popularity has also been associated with the emergence of a post-humanist orientation which rejects both a firm species barrier and the exceptionalism of humans over other animals (Cudworth 2011). While some scholars claim that we are witnessing the emergence of hybrid families (Franklin, 2007) or post-humanist households (Power 2008; Smith 2003) accompanied by the progressive destruction of the species barrier, sociologist Nickie Charles (2014) advocates for a more cautious analysis. Although Charles acknowledges a shift in the context of intimate relationships with pets, she challenges claims regarding the novelty of the advent of post-human families. Rather, she argues that multi-species households, with close emotional bonds between people and pets, are not new to the postmodern period.

ultimately accepted, albeit conditionally' (Ibid. 11). Harriet Ritvo (1987) associates the increase in pet-keeping during this period with the industrial revolution's 'taming of nature' that resulted in a shift in how the natural world was perceived; in short, nature was no longer considered a threat to human existence.

Indeed, domestic dogs have been a part of many households since Saxon and Celtic times (Ritvo 1987). According to Charles (2014, 12), this phenomenon is the 'continuation of a long-standing trend towards an increasingly widespread experience of affective human–animal connectedness'.

Certainly, the everyday acts of kinship people engage in with their pets—or indeed other categories of animals[4]—raise questions about the 'sharp divisions of nature and culture' (Haraway 2003, 30), illustrating the 'connectedness of humans and other animals and the permeability of the categorical barriers that separate them' (Charles and Davies 2014, 9.6).

ii. A Turn Towards Dogs

Dogs in Anthropology

While animals in general have long been considered outside the intellectual remit of a study of mankind, it is arguable that a further obstacle has prevented anthropologists from taking the dog, in particular, seriously as a subject worthy of inquiry in this animals' relations with humans. The ubiquity of the dog in western culture, their mundane presence within households and status as 'honorary humans' (Donaldson 2005, 8) has arguably contributed to the, until recent, scarcity of scholarship exploring human–dog relations. As Charles (2014) argues, although multi-species households have existed for a long time, the so-called 'species barrier' has effectively concealed them from inquiry within the social sciences.

However, as noted in the above discussion on the animal turn, animals, including dogs, have not been absent in earlier anthropological work. For instance, Caroline Humphreys (1976) has paid attention to the role of dogs in Mongolia, where she proposes the term 'intimate others' (1976) to encapsulate the particular position of the dog in relation to human beings. More recently, Baasanjav Terbish (2015) has built on

[4] Simone Dennis (2009) has explored how notions of kinship are tied to relationships between scientists and laboratory rodents in Australian laboratories. Dennis notes how a variety of kinship is established between the researchers and their animal subjects: a kinship established and enacted in the thickness of the encounters between the researchers and rodents, and formed by a recognition that both human and rodent bodies are sensing and sensible beings.

Humphrey's work, utilizing her notion of Mongolian dogs as 'intimate others' in his exploration of the apparently contradictory treatment of dogs in Mongolian nomadic society. Terbish illustrates how on the one hand, the status of dogs is elevated in this society given their cosmological proximity to humans. Among Buddhist Mongols, the dog is understood to be the closest being to humans in the circle of reincarnation and this intimacy is reflected in the practice of naming individual dogs: a custom not extended to other animals. At the same time however, there is a recognition that dogs are not equal to humans. Due to concerns about the dog's polluting state, dogs are prohibited from entering the *ger* [felt tent and home], people refrain from close physical contact with the dogs, and items are thought to be polluted if a dog steps over them. Furthermore, dogs are typically only provided with leftovers to eat. Drawing on Victor Turner (1979), Terbish proposes that the Mongolian dog is not only an 'intimate other', but can also be considered a 'transitional being', for it is neither a total beast nor a full human, instead it has elements of the two. During the socialist period however, when occult specialists were quelled and the cosmological realm was derided as superstition, the dog lost its status as a transitional being and was instead split into 'good' (domesticated) and 'bad' (stray). Pets and working dogs were invited to share living space and food with people, while stray dogs were hunted and killed as a matter of public health. Thus, Terbish argues that the Mongolian dog functions as a mirror of human society.

Humphreys' and Terbish's scholarship arguably maintains an overtly anthropocentric approach, with an emphasis on the human cultural and historical contexts for such relationships, rather than on the nuances of the relationship itself and how these nuances are tied to factors beyond the human. Significant exceptions to such anthropocentric scholarship on human–animal relationships where dogs are concerned include the aforementioned works of Haraway (2003; 2008) as well as that of Smuts (2001) and Kohn (2007): literature that recognizes the fundamental entanglement of dogs with everyday human life and illustrates the porous quality of the 'species barrier' within anthropology. For instance, Barbara Smuts (2001) draws on her personal experiences with her dog, Safi, in whom she encounters the presence of a 'self', in order to theorize the variety of cross-species intersubjective relations.

Despite being heavily focused on Euro-American contexts, the burgeoning scholarly interest on human–dog relations is not wholly restricted to such locales. Work has been undertaken across the world in an effort to understand the myriad and diverse ways in which people live and work alongside dogs. For example, Kohn (2007) has

conducted ethnographic work among the Amazonian Runa, in which he explores Runa ways of communicating with and knowing dogs in a 'perspectivist' (cf., Viveiros de Castro 1998) universe. Acknowledging the interconnectedness of human–dog relations in this context, Kohn (2007, 7) claims that 'in their mutual attempts to live together and make sense of each other, dogs and people increasingly come to partake in a shared constellation of attributes and dispositions'.

Elsewhere, in urban Japan, Paul Hansen (2013) has studied the recent boom in pet dog ownership, linking the phenomenon to his informants' desire for touch—both bodily and affective. Dogs are considered as family members here, Hansen argues, because they are individual agents with unique characteristics enabling them to impact us both physically and affectively. Largely bred to be companions, dogs in Japan 'fill an affect-oriented void; be it as family or friend' (Ibid., 92).

Domestication Reconsidered

Dogs share a unique relationship with mankind, as archaeological records suggest the dog was the first species of animal to be domesticated (Perri 2016). Consequentially, studies concerning the process and timing of dog domestication are closely tied to research exploring human evolution. However, despite having lived with humans for tens of thousands of years, the details regarding the dog's geographic and temporal origins are a continued topic of debate among scholars in this field. Amidst this lack of consensus though, one fact is widely undisputed: despite the great variety of dog breeds observable today, representing a broad spectrum of sizes and shapes, all domestic dogs are descendants of the grey wolf (*Canis lupus*) (Vila et al. 1997).

For some time, there have been two main schools of thought about dog domestication. Some scholars claim dogs split from wolves in Europe around 16,000 years ago (Clutton-Brock 1995; Freedman et al. 2014; Morey 1992), while others suggest dog domestication happened in Central Asia or China more recently (Ding et al. 2012; Savolainen et al. 2002). A recent study (Frantz et al. 2016) however, suggests that the explanation for these contrasting theories could be that all these claims might in fact be correct. Based on DNA analysis of ancient and modern dogs, the results of this study show a genetic split between modern dog populations living in East Asia and Europe. Dated to between ~14,000 and 6,400 years ago, this split appears to have occurred after the earliest archaeological known appearance of dogs in Europe (<15,000 years ago) and East Asia (<12,500 years ago) (Larson et al. 2012). The authors also suggest that there appears to

have been a population turnover in Europe, with the earliest domestic dog population there being largely replaced. Combined with archaeological evidence, Frantz et al. argue that the findings of this study suggest that dogs were domesticated independently from two geographically distinct wolf populations, one in Eastern Eurasia and the other in Western Eurasia. The researchers hypothesize that after some time, East Eurasian dogs may have then moved into Europe with migrating humans, where they mixed with and largely replaced the earliest European dogs.

However, this dual-origin domestication hypothesis has been challenged by a recent study in which ancient genomic data sequences of Neolithic dog fossils were compared with genetic data from canids, including modern dogs and wolves (Botigué et al. 2017). The ancient dogs were found to share ancestry with modern European dogs, challenging the hypothesis of a Late Neolithic population replacement. The researchers of this latest work put dog domestication somewhere between 20,000 and 40,000 years ago. Nevertheless, the debate continues.

Traditionally, the domestication process of plants and animals has been widely (though not unanimously) considered an act of human achievement encompassing notions of ownership, property, and control. This approach has been increasingly challenged in recent decades however, with some arguing that rather than illustrating the human species' control over other beings, domestication instead highlights our significant lack of control.[5] Concerning the domestication of the dog in particular, it has even been hypothesized that the dog domesticated itself (Coppinger 2002). For instance, Ray Coppinger's (Ibid.) theory proposes that wolves approached hunter-gatherer camps in search of food, with the friendlier wolves tolerated by humans and able to take advantage of human food waste. Certainly, the notion of dog domestication as a more mutually shaped endeavor between the species has been increasingly advanced in recent years, with Haraway (2003, 5) referring to humans and dogs as 'Partners in the crime of human-evolution'.

[5] As Helen Leach, quoted in Sarah Franklin's *Dolly Mixtures* (2007, 31), claims: 'However it is defined, domestication was a process initiated by people who had not the slightest idea that its alliance with agriculture would change the face of their planet almost as drastically as an ice age, lead to nearly as many extinctions as an asteroid impact, revolutionize the lives of all subsequent human generations, and cause a demographic explosion in the elite group of organisms caught up in the process. Such unforeseen consequences are seldom discussed in the literature of domestication, perhaps because it is not in the nature of the species that started the process to admit that it isn't in control'.

This reconsideration of the process of domestication, as one that was probably a less active experience on the part of the humans than has often been thought, resembles a broader shift in approaches towards domestication that emphasize the interspecies mutuality of the process by reconfiguring the development of relationships between people, animals and plants. Such a shift in thinking has been greatly informed from the work of scholars outside of anthropology. In particular, Despret's (2004) work has been important in reconceptualising approaches to domestication. Despret presents a review of Robert Rosenthal's 1966 experiment with rats and biology students' study of rats, intended to test the supposed 'Clever Hans effect', whereby scientists unconsciously influence results. In Rosenthal's study, the students are each given a rat for whom they were responsible for working with. The rats' task was to navigate a maze. Half the students were told that their rats had been selectively bred to be particularly intelligent, while the other half were told that their rats were particularly dull. In fact, both groups of rats had been bred under identical conditions. Matching Rosenthal's expectations, the 'bright' rats outperformed the 'dull' rats. Despret argues that in this case the students and rats mutually participated in a process of attunement. She notes that the students 'put their trust in their rats, emotional trust, trust that is conveyed in gestures, in students' bodies, in all these rats' bodies that were manipulated, caressed, handled, fed, and encouraged'. This led to 'the students succeeding in attuning their rats to their beliefs', and 'these beliefs brought into existence new identities for the students and for the rats' (2004, 122). For Despret, the emotional relations between the species in this case are elements of domestication as she perceives it, as an 'anthropo-zoo-genetic practice' through which human and animal are constructed. This example illustrates Despret's contention that *how* questions are asked of animals intimately determines what the animal is allowed to become (e.g. 'dull' or 'intelligent').

According to Despret, what Rosenthal's study demonstrated was 'how an affected and affecting student makes himself available to the 'becoming' of the rat' (2004, 123). However, Despret points out that her notion of 'becoming available' is not equivalent to 'being docile' and the difference, she notes, rest on the possibility of 'resistance' that is not shared by both practices. Experimental methods that enable beings to 'become available' to each other enable resistance, whereas experiments that are designed to produce docility do not. It is precisely this process of becoming available that Despret terms as domestication. In my analysis of the training of bio-detection dogs I will draw on Despret's work, particularly exploring the potential for resistance within this arena and

asking how this reconceptualization of domestication can help us to understand the shape of human–dog relationships.

The Coevolution of Human–Dog Communication

As a consequence of the thousands of years that humans and dogs have spent living alongside each other, dogs have evolved not only in the way they look, but how they behave too. Particularly interesting to note is the evidence that suggests dogs have developed an array of cognitive capabilities that enable them to effectively read and respond to human communicative behaviour (Cooper et al. 2003; Miklosi et al. 2004). The basic test used to demonstrate this is the 'object-choice task'; a popular experiment in the field of dog-cognition. During the experiment, a human hides a piece of food under one of several opaque bowls or cups, controlling for factors such as smell, and then gives a specific communicative cue to the dog to indicate the 'target' cup. In the first study of this kind to be conducted with dogs (Miklosi et al. 1998), five gestures were used sequentially: pointing, bowing, nodding, head turning, and glancing with the eyes. Each gesture was offered to the dogs at least thirty times before the next was introduced and eighty per cent accuracy had to be shown for the present gesture before progressing to the next. All six dogs in this study proved competent in using these gestures to approach the correct bowl without prior training. Successive studies have confirmed the validity of these results (Agnetta et al. 2000; Hare et al. 1999). Human infants are capable of recognizing these communicative signals from around 14 months old (Behne, Carpenter, and Tomasello 2005), whilst chimpanzees—despite their ability to solve many other cognitive tasks (Tomasello et al. 2003; Povinelli, and Vonk 2003)—display no skill in reading these communicative behaviours to find hidden food (Tomasello, Call, and Gluckman 1997).

Given the difficulty that some of our closest relatives have with this task, it is significant that dogs show remarkable skill in reading human gestural cues to extract social information. Brian Hare and colleagues (2002) propose the term 'phylogenetic enculturation' to describe the process through which dogs have been selected for particular social-cognitive abilities, that enable them to surpass even chimpanzees in understanding human communication. Despite their capabilities communicating with humans however, it is worth noting that dogs are not better skilled in *all* communication tasks compared to

other animals.[6] Nevertheless, as a whole, this body of research contributes to our understanding of why dogs, in particular, appear so well-suited to living and working alongside humans today, and accounts for their depictions as 'students of human movement' (Gladwell 2006), or 'canine anthropologists' (Horowitz 2010, 161).

The flourishing of the field of dog-cognition over the past two decades has led to many more experiments being conducted, including a broader set of gestures tested among dogs in object-choice studies.[7] This mode of incorporating dogs into scientific research represents a shift away from the mode in which they were typically studied throughout the twentieth century—as mere neural systems in the development of learning theory (e.g., Pavlov 1966a [1906]; 1966b [1936]—and towards a consideration of dogs as a species itself of curiosity, no longer solely of interest for what dogs can reveal about human physiology.

However, Alexandra Horowitz and Julie Hecht (2014), researchers at the Dog Cognition Lab within Columbia University's department of Psychology, highlight the anthropocentrism implicit in the methodological design of some of the studies in dog-cognition. In particular, they question the salience of visual cues for the dog: 'a species whose primary modality is olfactory' (Ibid., 210). To counter this, they suggest that dog-cognition studies ought to be designed with sensitivity towards the dog's *umwelt* (von Uexküll, [1934] 1957), the subjective or 'self-world' of each individual and species. Regarding the area of dog-oriented research at the center of this thesis, whilst not itself a study of dog-cognition per se, I consider how my human informants engage with ideas about how dogs perceive the world.

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[6] Whilst dogs have proven more skilled than nonhuman primates in object-choice tasks, they are less able in other *non-social* tasks. For example, dogs are unable to make inferences about the whereabouts of hidden food based on non-social cues, such as seeing one board flat and another tilted up as though something were underneath (Bräueur et al. 2006). In this task dogs do much worse relative to nonhuman great apes. These results are intriguing and suggest that the skills demonstrated by dogs in the object-choice task exemplify a precisely *social* specialization.

[7] In subsequent studies (e.g., Hare and Tomasello, 2005a; Udell et al. 2008), dogs have been found to infer the correct object from a human placing a marker on the object. Even when the marker is removed from the object prior to the dog making his choice, the dog still chooses the correct object, suggesting that the dog is not simply attracted to the marker but responding to the cue (Reidel et al. 2006).

Working Roles of Dogs Throughout History

Given the evidence from developments in dog-cognition, regarding the dog's communicative abilities with humans, it is perhaps not surprising that humans have utilized dogs to work alongside them throughout history. Even prior to the domestication of modern dogs, their canine ancestors are believed to have formed a significant alliance with humans, helping them to hunt more efficiently.[8] Since these early human–dog encounters, labour has continued to remain highly significant in the relationship between humans and dogs. In addition to hunting however, dogs around the world have also been enrolled in tasks of transportation, hauling goods and people, as well as the herding and guarding of livestock.

The more recent emphasis on breeding dogs for 'jobs' that are based on high-status skills—including guide dogs, hearing dogs, and detection-dogs—have been considered as contributing to the 'professionalization' of working dogs (Edminster 2011a; 2011b). Increasingly, these 'careers' warrant their own breeding programmes specifically designed to select for and produce dogs with the higher-status skills needed to conduct such work. As Avigdor Edminster (2011a) notes, such roles can be distinguished from many other types of 'working dog' categories, such as guarding or retrieving game, by virtue of the fact that these professional roles are based around tasks that their human partners, by definition, cannot do. This is certainly the case for bio-detection work, where dogs are unequally endowed with a superior olfactory capability, and I will consider how this difference is implicated in the practices involved in the training of bio-detection dogs. Building on Edminster's (2011a; 2011b) ethnographic insights from his field experiences from within a north American assistance-dog agency, I will also examine the use of 'career' terminology surrounding the 'working dogs' within my own field sites.

[8] This suggestion is based on Pat Shipman's (2015) theory that as modern humans arrived in Europe some 45,000 years ago, Neanderthals abruptly disappeared. Shipman (2015) claims that the domestication of 'wolf dogs' by Homo Sapiens was key to the extinction of the Neanderthals, and the subsequent survival of Homo Sapiens, as these animals aided our ancestors in hunting large Ice Age mammals more efficiently and safely than the Neanderthals could.

iii. Science

a. Making Scientific Facts

To develop an understanding about the complexities of how knowledge is produced about and with dogs, in this thesis I will draw on conceptual tools from the field of science and technology studies (STS). The study of science—where science is considered as a particular way of knowing the world—gained pace during the 1970s and 1980s as several scholars began entering laboratories in order to study everyday scientific work. Inside the laboratories, the scientists became the anthropologists' 'tribe' (Latour and Woolgar 1979). These early researchers, notably including Bruno Latour and Steve Woolgar (1979), Karin Knorr-Cetina (1981) and Sharon Traweek (1988), sought to understand how facts are 'made' in the space of the laboratory. To this end, these scholars have deconstructed the notion of scientific facts as 'nature' waiting to be uncovered by scientists. One of the first 'laboratory studies' was conducted by Latour and Woolgar (1986 [1979]) who, through observations of the daily interactions and processes within a single laboratory, argued that rather than occupying a realm of truth and objectivity separate from the 'social', science is in fact a social activity and scientific facts ought to be understood as 'constructed' through long and laborious procedures, rather than conceived of as 'out there' in nature. This approach presents a significant challenge to the established epistemological division of labour that relegates the discovery of universal and objective truths to the natural sciences, and the exploration of social and cultural processes to the social sciences. It is this conceptual separation of nature and culture, and persons and things, that Latour identifies as the fundamental organizing principle of modernity in *We Have Never Been Modern* (1993). According to Latour, modern knowledge practices work to imbue phenomena with these binary categories in a process of 'purification' which effectively separates the social from the natural so each appear 'pure'. Paradoxically, this work takes place in a world of increasingly blurred boundaries, in which 'mixtures between entirely new types of beings, hybrids of nature and culture (1993, 10) are constantly produced. The proliferation of nature and culture hybrids, or 'nature-cultures', is described by Latour as 'the work of translation' (1993, 11), whilst it is through modernity's obsessive practices of purification that such hybrids are effectively concealed.

Modernity's blind opposition between nature and culture, and subject and object, is challenged by the actor-network-theory (ANT) approach developed by Latour and

colleagues (Callon and Latour 1981). However, rather than a programmatic theory, ANT emerged as a loose methodological 'toolkit' or 'sensibility' (Law 2004, 157) for mapping how each object or actor is shaped in its relations. For proponents of ANT, a-priori distinctions do not exist between actors of either human or nonhuman kind, and no actor has a reality or form outside the webs of relations within which they are located. Thus, in Latour's historical ANT study of the work of Louis Pasteur, he demonstrates the mutual dependency of a variety of entities including Pasteur, microbes and microscopes, arguing that the emergence of modern microbiology, was as much a result of the agency of the microbes as it was a product of the individual 'genius' of Pasteur himself.

For Latour and Woolgar (1979), central to the processes of purification and translation are 'inscription devices', or the various machines and technology of scientific experiments that produce simple written traces (e.g., diagrams, tables, pictures). The power of these devices, they argue, lies in their capability to remove the data from its original context, making it appear as 'raw nature', and to limit the number of potential counter-arguments to the data. Shifting an explanation from 'it is probable that A equals B' to 'X has shown that A equals B', is enough to achieve a scientific fact (Ibid.). Inscription devices are thus said to give science its authority and power (Ibid.). Birke (2007 [1994]) notes the universality of this process within the scientific arena, stating that, 'It does not matter what is studied, all laboratories rely on devices that churn out written traces: graphs, tables of numbers, abstract symbols. It is these that create 'data', the facts of the scientific experiment, and help to create an air of authority about those data' (328).

In Birke's work (2012), in which she notes her Latourian influence, she also adopts a broadly ANT-inspired perspective in identifying the laboratory animal as an actor within networks of people, animals and things which comprise experimental scientific practice. Whilst ANT can be a useful approach to help identify the various and often taken-for-granted actors with whom humans live and operate, its insistence on a flat assessment of all actors within a network, reducing individuals to effects, is problematic. For Latour 'no one lives in a 'culture', shares a 'paradigm' or belongs to a 'society' before he or she clashes with others' (1987, 201). Thus, an ANT approach maintains that no actor exists independently outside the enactment of the webs of networks within which they are situated. Consequentially, the deficiency of an ANT-informed methodology is its ignorance of the role that power differences between beings—for instance race, gender or class—can have on who or what is permitted to form connections. Although I agree that encounters certainly constitute social actors, I maintain that creatures of many kinds are

simultaneously individuals with multifaceted qualities. In this thesis, I therefore adopt an approach more in line with that proposed by the sociologist Rhoda Wilkie (2015, 330), who advocates for building a more contextualized understanding of interspecies relations that accounts for 'where species are located in a network and any power differentials that may exist between and amongst human and nonhuman animals'. As Erika Cudworth (2011, 77) recognizes, 'Animals have more or less limited agency, depending on the kind of environment they are in'.

Joan Fujimura (1988; 1992; 1996) also explores the production of scientific knowledge, asking how and why certain theories become facts. Fujimura is interested in understanding how scientific facts move across diverse social worlds. Using the case of the 'molecular biological bandwagon' (1988) in cancer research, she explains how and why this particular idea became fact across myriad different social worlds. The fundamental theory of the molecular biological bandwagon in cancer research was that of the 'proto-oncogene' theory, which claims that 'normal' genes can, when altered by mutation, become 'cancer genes'. The technology, or method, that Fujimura recognizes as pivotal in enabling support for this genetic theory of cancer across different social worlds, is recombinant DNA technologies. Combined, Fujimura argues, this theory and set of methods—the proto-oncogene theory and recombinant DNA technologies—illustrate an example of her notion of 'standardized packages' that are put in place to maintain the integrity of the interests of the diverse social worlds the theory was permeating, while simultaneously providing them with new standardized tools for conducting their work. She describes 'standardized packages' as consisting of 'a scientific theory and a standardized set of technologies which succeeded in enrolling many members of multiple social worlds in constructing a new and at least temporarily stable definition of cancer' (1992, 176-7).

Considering what happens to a fact once it has been established, Annemarie Mol (2000) has, based on her ethnographically-informed analysis of the relations between medical knowledge and its objects, challenged the notion that facts simply sustain themselves. Instead, Mol argues, the reality of 'thick vessel walls' (the pathological enactment of atherosclerosis, a disease in which plaque builds up inside a person's arteries) are at risk of becoming invisible if they are not routinely 'performed': 'If the dust cover is left on the microscope, the pink and purple cross sections, however impressive they are now, will

fade away. It is this requirement of repetitive re-enactment that the theater metaphor *performance* gets across quite well' (Ibid., 86).

Drawing on Mol's insights, I will explore how the scientific facts generated about and with detection dogs are re-enacted in everyday practices. I suggest that training and working with detection dogs are practices that must be repetitively performed, following certain 'scripts' and employing particular instruments and skills that will be elucidated in this thesis. Following Mol, it is my contention that these practices can be traced and made sense of ethnographically, particularly if the relation between detection-dogs, their trainers and the odours they are searching for is theorized in terms of performance.

Rather than illustrating knowledge production as a straight forward process, science studies have highlighted the messiness of laboratory life and scientific practice more broadly, with the concept of 'tinkering' emerging as particularly useful in analyzing how scientific and medical advancements emerge (e.g., Knorr-Cetina 1981). The notion of tinkering draws on Francis Jacob's (1977) use of the term, whereby he employs the image of *bricolage*, or tinkering, to describe the process of evolution by natural selection. Like natural selection, he suggests that a tinkerer works without a specific goal in mind, employing whatever materials are available to him, and shapes them into a workable object. Thus, he describes tinkerers as producing objects that represent 'not a perfect product of engineering, but a patch work of odd sets pieced together' (Ibid., 2).

b. Animals in Science

Many scientific advancements are tied to the lives (and deaths) of animals who have been enrolled, frequently as model organisms, to help develop understandings of the disease process and the viability of potential treatments. Such practices have garnered scholarly attention from social scientists, with questions focused particularly on the shape of human–animal relationships in this field of research as well as the role(s) of the animals themselves.

The research dimension of work with bio-detection dogs falls outside the remit of 'animal research' as defined in UK and US law. Nevertheless, anthropological literature on animal research remains relevant for the questions explored in this thesis with regards to the production of a particular kind of lively diagnostic tool under scientific study. Work from anthropology and related social science disciplines have identified the various and

often conflicting ways in which relations between human and animal have been represented in order to facilitate experimental goals and produce scientific knowledge (e.g., Arluke 1988). Whilst there are ostensible contrasts between the experimental uses to which the bio-detection dogs and the animals of laboratory research are put—differences which are identified through engagement with this literature and which I acknowledge throughout this thesis—insights from this scholarship, especially regarding the structure of human–animal relations in science, are drawn on to help develop a critical analysis of the creation and study of the bio-detection dog. Thus, although the literature on animal research is not a perfect comparative for understanding the creation and study the bio-detection dog, it is nevertheless a productive body of work from which contrasts can be made.

In addition, an acknowledgment of the wider context(s) within which animals have been utilized and conceptualized by scientists, and how their use in biomedicine has provoked public reaction, helps to make clear the fundamental and contested role of animals within science and society. Whilst the bio-detection dog falls outside the scope of animal research, an awareness of this arena of study offers insight as to why, at least in part, the organisations training bio-detection dogs—both funded by public donations to varying degrees—are both observed to be invested in the portrayal of a particular image of the bio-detection dog.

Considering how animals have been incorporated in the field of scientific and medical research returns us to questions of boundaries introduced in the above discussion of the animal turn. According to Lynda Birke and colleagues (2004, 173), the practice of science sustains a boundary between animal and human: 'The long history of standardization, use of the passive voice, legal frameworks of animal experimentation, and ethical justifications for using nonhuman animals—all these operate to maintain a clear discontinuity between humans and other animals. They serve to separate humans from nonhumans, both in time and space, and conceptually'.

Birke (2007 [1994]; 2003; Birke and Smith 1995; Birke et al. 2004) in particular has contributed significantly to science studies on the topic of animal research, with her work focusing especially on scientific practices involving laboratory rodents. Bred specifically for scientific research, rats and mice are undoubtedly the most well-known animals of scientific research and have garnered a considerable degree of scholarly focus

(e.g., Birke 2003; Birke and Smith 1995; Birke et al. 2004; Davies 2012; Davies 2013; Dennis 2009; Lynch 1988).

Considering the iconic status of the laboratory rodent, Birke (2003, 211) notes, 'Laboratory rats and mice are now potent symbols of scientific endeavor; indeed, they stand alongside the ubiquitous double helix as icons of the laboratory in modern western culture'. Birke argues that from the early twentieth century, the laboratory rat was selected for and bred, materializing the demand for standardization that typified the mandate to be 'more scientific' (Birke and Smith 1994). Birke's (2007 [1994], 329) ethnographic research illustrates how, within the spaces of scientific practice, the work 'must be fitted into the demands of the technology'. In effect, as Mary Midgley (2003, 211) writes, in the laboratory, the rat is 'simply a standard object, a piece of laboratory equipment with the function of being used to test hypotheses, a kind of purpose-made-flesh-and-blood-robot'.

Although animals used in research are in many instances shown to be objectified by de-individualizing practices, Arnold Arluke (1988) has pointed out that laboratory personnel often simultaneously develop pet-like relationships with research animals. For instance, Arluke found that frequently, in biomedical research facilities, an individual animal would be singled out by laboratory staff and adopted as a kind of laboratory pet, removed from a fate of experimental use or euthanasia. Sometimes the animal would even be taken home by a member of laboratory personnel. Arluke notes that the more closely individuals work with animals, the more likely they are to form bonds with them. Thus, it is often the animal care staff who become most closely attached to the animals, rather than the senior scientists.

Arluke's insights illustrate the contradictions that exist in animal research staff's perceptions about the animals they study. A sense of ambivalence is also reflected in the language used by laboratory personnel to describe what occurs in laboratories, where, for instance, animals are typically said to be 'sacrificed', rather than killed (Arluke 1988; Lynch 1988). Such observations reflect the notion that human relationships with animals are often complex, multi-layered and full of contradictions and ambivalences (Herzog 2010). As Andrew Rowan is quoted to have said, 'The only thing consistent about human–animal interactions is paradox' (Rowan quoted in Herzog et al., 1997: 236).

This thesis asks how the bodies of bio-detection dogs are disciplined at the nexus of dog training and research, paying particular attention to the dog's individuality and how this is effected or curtailed by the particular research conditions.

iv. The Social and Political Context of Animal Research

The use of animals in scientific and medical research is a topic of significant debate around the world. Attitudes towards the acceptability of laboratory animal research are complicated and vary depending on the extent to which there exist 'no alternatives, minimization of harms to animals, and benefits for human and/or animal health' (Davies et al. 2016, 3). Rather than remaining stable, opinions about experimental practices involving animals have shifted over time, reflecting changes in both scientific and social assumptions. Several scholars offer comprehensive overviews of the social and moral issues on the topic throughout history (e.g., Franco 2013; Guerrini 2003). Here, I will comment on several of the most relevant social, political and philosophical factors for the case study explored in this thesis, in order to provide the reader with a summary of the political and social context within which my informants' work ought to be situated.

Intelligence and Sentience

The way animals have been incorporated into scientific practice has been largely associated with dominant philosophies about the purported similarities or differences between human and animal. Emphasizing a division between human and animal, in the seventeenth century, René Descartes promoted the notion that animals are without a mind and are thus incapable of thought, reason or rationality. Moreover, in describing the animal body 'as a machine' Descartes (1988 [1637]) is widely understood to have promoted the understanding of animals as 'machine-like'. This Cartesian mechanism view of animals was used to defend animal experimentation, including attempts to justify vivisection in the seventeenth and eighteenth centuries (Boden 2006; Rupke 1987).

The supposed absence of rationality is one of many factors that have been used to maintain a distinction between human and animal and thereby justify the animal's pain and suffering in experimentation. Another aspect that has been important in shaping attitudes towards the use of animals in research has been the question of sentience, or the capacity to feel. As Jeremy Bentham (1789, 283) famously proposed, 'The question is not, Can they reason? Nor, Can they talk? But, Can they suffer?'. Regarding the shift from a focus on animal intelligence to sentience, Nuno Franco (2013) notes, 'these philosophers

proposed a shift from an anthropocentric justification for our duties of kindness to animals, to human obligations towards other animals for the sake of the animals themselves' (245).

Today, sentience remains central in debates about how animals ought to be understood and treated. Recently, in the UK there has been public outcry over the governmental vote to exclude provision to transfer the principle contained in Article 13 of the Lisbon Treaty, recognizing animals as sentient beings, into UK legislation on the UK's exit from the European Union.[9] Animal welfare campaigners have expressed concerns because UK law, under the *Animal Welfare Act 2006* does not explicitly recognize the term 'sentience', although it does acknowledge that animals can experience suffering and pain.[10]

An important turning point in public opinion concerning animal welfare was the publication of Ruth Harrison's *Animal Machines* in 1964. Although this focused on farmed animals at the outset of the intensive farming movement, her argument that animals under conditions of intensive farming are reduced to mere units of productivity—or 'animal machines'—applies too to the animals of laboratory research. Several years before this publication, the concept of the '3Rs' approach to experimental research with laboratory animals was introduced by William Russell and Rex Burch (1959). In this, Russell and Burch introduced the terms 'replacement', 'reduction', and 'refinement' as alternative methods for minimizing the pain and distress experienced by animals in laboratory research. Both publications are concerned with animal welfare, or the physical and mental state of an animal, related to the absence of negative emotions. These works sparked a shift towards a culture of greater compassion and respect for the nonhumans whose lives are entangled in scientific and farming practices. Regarding farmed animals, Matthew Cole (2011) notes that the 'emotional turn' in animal welfare discourse (Terluow et al. 2008) has necessitated a reshaping of human relations with farmed animals. In the place of mechanistic discourses about these animals, a regard for the potential of empathetic knowledge between species has emerged.

[9] https://www.independent.co.uk/voices/brexit-government-vote-animal-sentience-cant-feel-pain-eu-withdrawal-bill-anti-science-tory-mps-a8065161.html

[10]https://www.rspca.org.uk/whatwedo/latest/details//articleName/2017_11_21_AnimalSentience

Dogs in Scientific Research

Considering the position of dogs, in particular, in relation to scientific research is important given the privileged social status they occupy relative to most other animals within the Euro-American cultural context of my research. Indeed, the closest relationships many people have with nonhuman animals today is with their domestic pet, most commonly in the form of a dog (PFMA 2015). Furthermore, the dog occupies an intimate, liminal position within the household, on the boundaries between human and animal (Fox 2006), thus setting apart the human–dog relationship from human relationships with a majority of the animals widely used in laboratory research, such as mice and rats. Analysing the strength of this implicit social contract between humans and dogs, Larry Carbone notes the symbiotic relationship between human and dog that began during the process of domestication:

> In the case of dogs, I suggest that it is not their sentience or their size so much as their long-standing symbiotic relationship with our own species that counts for so much…Dogs and humans have lived symbiotically for eons…Symbiosis does not mean equality, however…What moral implications does this long coevolution entail? Does it entail special obligations to dogs that other animals do not merit? It does not, in the eyes of many of the major philosophers writing about animals: it makes them no more or less sentient than other animals…But in the public eye, the symbiotic relationship of dogs with humans definitely calls for a special ethic. (2004, 83)

However, the emotional bond widely felt between people and dogs has, at times, been used to justify the use of dogs in certain research programmes. For instance, Diane Paul (1991) notes why Alan Gregg of the Rockefeller Foundation enrolled dogs—rather than any other animal—in a post-war study of genetics and social behaviour. Although the heritability of behavioural traits had already been demonstrated in organisms such as fruit flies and rats, Gregg is understood to have believed that these animals were beings 'to which few persons could relate to emotionally' (Ibid., 273). The dog, in contrast, was becoming an increasingly popular pet in the USA: an animal with whom many people shared emotional bonds and experienced a sense of continuity with.

While dogs do continue to be used in invasive experimental research today, there has been a recent rise in non-invasive modes of research using dogs, particularly in the

study of dog-cognition (e.g., Call et al. 2003; Hare and Tomasello 1999; Miklosi et al. 1998; Racca et al. 2010). This kind of research is distinct from laboratory studies, most notably with regard to the kinds of animals used. As Horowitz and Hecht (2014, 202) point out, 'the subjects are most often owned dogs, household pets, whose social group is as much humans as it is conspecifics. This fact distinguishes them from almost all other research subjects, in lab, farm, or field; either domesticated or not'.

Furthermore, in the field of dog-cognition, the animals are not forcibly restrained or sedated but typically encouraged to participate with the researcher's use of positive reinforcement training (e.g., Berns and Cook 2016). Describing their fMRI studies involving dogs, neuroscientists Gregory Berns and Peter Cook (Ibid.) refer to the dogs as 'cooperatively' participating.

The recent upsurge in the field of dog-cognition reflects the broader shift in the methods and questions of some scientists that Despret (2004) notes has occurred during the latter three decades of the twentieth century: 'These scientists aim to find new methods to focus, as some primatologists put it, on those behaviours that are most meaningful to the animals themselves' (54). Whilst not a study of dog-cognition, the case study of bio-detection dog training and research, explored in this thesis, is illustrative of this broader animal-centered approach to research with animals, whereby the training and research methods are designed to focus on what is important to the dogs themselves. By paying attention to the dog's perspective, with the adoption of novel methods and questions, there is an opportunity for this kind of research to challenge notions of human exceptionalism.

Situating the bio-detection dog

Amidst the literature regarding animals in working roles and animals in science, the bio-detection dog represents a curious being for analysis. Trained to perform a particular skilled role, these dogs are recognizable as working animals, akin to dogs used for a variety of purposes—from bomb-detection to search and rescue work. However, as animals whose purpose in this role is to enable the yielding of scientific data, the bio-detection dog embodies a dual character as a working animal whose skills are utilized for scientific purposes. Unlike model organisms, however, which Rachel Ankeny and Sabina Leonelli (2011) have argued represent a distinctive kind of research animal, set apart by their role to facilitate comparative modes of research via their wide representational scope, the bio-detection dog does not function as a scientific model.

To help clarify what kind of being the bio-detection dog is, we can consider another mode, distinct from model systems of disease, in which animals have been utilized for scientific purposes: the use of animals as diagnostic tools (Kirk 2009). In his analysis of the use of diagnostic animals by the British Laboratory Animals Bureau during the mid-twentieth century, Robert Kirk (2009) describes how these animals were utilized to measure the potency of drugs such as amphetamine, noting that this pharmaceutical use of animals differed from their use in physiology, with regards to the animal's purpose and construction. Regarding the use of animals in physiology, the animal was both the subject and object of knowledge. In the pharmaceutical use however, 'the subject of knowledge was biochemical substances and the animal served as no more than a purportedly objective diagnostic technology' (516). Thus, Kirk argues that the pharmaceutical sciences utilized the animal as a measuring device that was required, and typically presumed to be, a mechanistically reliable tool' (Ibid.). In contrast, bio-detection dogs are understood not only as a kind of diagnostic tool but as living, social beings, with individual personalities and social relations with their handler that are a source of potential variance.

v. A Note on Terms

Given the topic of this thesis, a brief note on language and categories is required to precede the main body. Firstly, where distinctions between humans and nonhuman animals are themselves at issue, I will now refer to the nonhuman animals simply as *animals*. Whilst I recognize that humans are of course animals as well, I use the terms *humans* and *animals* for the sake of brevity.

Echoing how my human informants conceptualize the dogs with whom they work, I understand the dogs in this thesis to be sentient beings with consciousness and a capacity for thought and feeling. Thus, I use personal pronouns of 'who' and 'he'/'she' rather than 'which' or 'it'. When referring to specific dogs, whose sex I know, I use the relevant gender-specific pronoun 'he' or 'she'. When discussing the dogs non-individually and more broadly, I adopt the masculine pronoun for linguistic consistency. This use of personal pronouns reflects how my human informants tend to refer to the dogs with whom they work.

Finally, a subtle but important distinction concerning the roles of my informants, that I became aware of during my time in the field, is that between the categories of dog 'handler' and dog 'trainer'. While the terms are sometimes used interchangeably, because a trainer also handles dogs, handlers sometimes do not themselves play a role in the dog's training process. Thus, dog trainers are considered to have greater expertise and knowledge in the skill of training, than handlers who might more modestly task the dog to carry out activities that he is already trained to do.

To offer an example, sometimes in the world of 'working dogs', for instance typically in the context of police dogs, a dog is trained by a trainer and then sold on to a handler who, whilst performing maintenance training with the dog, is not considered a 'trainer' per se. Except for the interns and volunteers, my informants are all trainers. Thus, for consistency, whilst making clear when the dog is being handled by an intern or volunteer, I use the term 'trainer' to refer to my informants throughout this thesis.

Alongside training dogs however, my trainer informants also adopt the more informal role of researchers, collecting data regarding each search during training. To acknowledge the multiplicity of their role, where discussing the research aspect of their work, I refer to them as 'trainer-come-researchers'.

vi. Summary of Chapters

Through the chapters presented in this thesis, four key research questions are explored:

1. *Through what practices are bio-detection dogs produced?*
2. *How can we theorize the role of bio-detection dogs in these practices? Are they simply lab-tools whose bodies are merely worked on, or co-workers who actively shape the training and research processes?*
3. *How is the information offered by a bio-detection dog transformed into evidence that is meaningful in human relations?*
4. *Under what social, economic, political and historical conditions has this practice emerged?*

Chapter 2 addresses the question of methodology, covering the how, the where and the who of this study. This chapter also confronts the methodological challenges of conducting

research ‘beyond-the-human’, exploring how I accommodate the perspectives of the dogs into this thesis.

Chapter 3 presents the reader with the vital context of the relatively novel practice of training dogs to detect the odour of human disease. Engaging with ethnographic vignettes tracing the emergence of this practice, this discussion considers how this practice has gradually shifted from a collection of anecdotal stories to scientific fact. Here, some of the key actors and spaces central to the bio-detection dog training process are also introduced. Outlining the particular kind of labour performed by detection dogs and their trainers, this chapter highlights several aspects of this practice that set it apart from other categories of working dogs in more conventional or familiar fields of scent-detection and medical assistance. As a whole, this chapter lays the groundwork for the subsequent chapters.

Chapter 4 examines the particular shape of human–dog connectedness in the training practices of bio-detection dogs. Through an engagement with the particular pedagogy of dog-training that underpins the training practices employed by my informants, their implicit perceptions about dogs and their assumed relation to, or with, humans are revealed. By employing ‘positive’ methods of dog-training, that eschew a dependence on force, I interspecies ‘response-ability’ (Haraway 2008) is not only enabled by, but in fact imperative to the training approach. I propose that this is because successful training without recourse to force obliges the trainers to adopt a constant curiosity about the internal states of the individual dogs as beings with distinct personalities, as well as a recognition of the dog’s olfactory capabilities that exceed those of the trainers. This exploration of how trainers and dogs work together finds an attentiveness to the nonverbal to be a fundamental element of successful training, with trainers required to ‘listen’ to dogs—who ‘speak back’—in order to facilitate the transmission of knowledge across the species. As well as the more ostensibly engaged modes of human–dog interaction that comprise the practice of listening to the dog’s body, I also highlight how, in certain moments, an affective distance between human and dog is enforced in order to shape dogs into good research subjects.

Chapter 5 shifts the focus beyond a mere recognition that the dogs have the capacity to speak back, examining how the dog’s perspective is thus incorporated into everyday practices, considered through the lens of care. Here, the trainers’ propensity to become

available to the needs and desires of each individual dog is understood as a practice of care, illustrated through examples of dog-grooming and the 'tinkering' (Mol et al. 2010) of equipment.

By considering the trainers' attentiveness to the dog's preferences and aversions, I demonstrate how more 'care-full' (Greenhough & Roe 2011) practices of training and research are fostered in this context. I argue that such an approach to care is sustained in part due to the research protocol in place in these spaces, that promotes ongoing encounters between individual humans and dogs. In this discussion, the agency of the dogs is highlighted, as their actions are revealed to be key in shaping the actions of their humans.

Chapter 6 considers how, by attending to what is considered most meaningful to the dogs themselves, the trainers' ethical impulse to help each dog fulfil his potential is realized. The chapter explores my informant's usage of terminology that emphasizes notions of canine 'choice' and 'careers' in their articulations of the dogs' labour. While acknowledging these organisations' projections of particular notions of personhood onto the dogs, I illustrate how the specific careers of bio-detection dogs are, in practice, mutually negotiated by human and dog.

Chapter 7 ties together many of the themes considered in the earlier chapters to assess how scientific knowledge is produced and communicated in the context of bio-detection dog training and research. I identify the practices that transform the dog from a behaving being into 'data', revealing the co-existence of multiple representations of the dog.

Highlighting the importance of interpretation, as a key mode through which knowledge is produced in these spaces, I observe that the object under study in this arena is more fruitfully conceived not solely as the detection accuracy of the dog, as an isolated entity, but instead the collective detection accuracy of particular human–dog dyads who work interdependently to produce knowledge about odour, disease and its detection.

Given this chapter's focus on interpretations of animal behaviour, it is here that I offer reflections on the question of anthropomorphism in the practices of my informants. With attention to the handlers' practices of 'speaking for' (Sanders and Arluke 1996) or speaking about, dogs, I argue that rather than pure, or conventional, anthropomorphism, their approach is more aligned with a 'critical anthropomorphism' (Morton et al. 1990) that acknowledges the dog's specific *umwelt* (von Uexküll, [1934] 1957). Instead of attempting to project human qualities onto the dogs, I illustrate how the trainers attempt to

adopt the (inevitably) partial perspective of the dog. Thus, in their intersubjective engagements, the boundary between human and animal, often assumed to be rigid in the sites of scientific practice, is continuously negotiated.

Throughout the chapters, two themes in particular emerge. Firstly, the work that my informants are engaged in is found to be a practice of ongoing boundary-navigation concerning multiple frontiers. Also developing throughout the ethnography is an illustration of the multiple meanings that the dogs embody for the various human social groups within which the dogs' lives and labour are entangled.

Chapter 2. An Anthropologist Goes to the Dogs: Methodology and Ethics in Field Sites Beyond-the-Human

i. Field sites

Medical Detection Dogs (Buckinghamshire, UK)

Medical Detection Dogs (MDD) is a charity that trains dogs to detect the odor of human disease, for two similar but distinct roles. One branch of their work is the training of 'Medical Alert Assistance Dogs': dogs that are trained to detect changes in an individual's odor, triggered by their disease (e.g., Type 1 diabetes), and alert them to an impending medical event (e.g., a dangerous rise or drop in blood glucose levels). Once trained, the MAAD lives and works with the person they are paired with, much in the same way as a Guide Dog lives with a paired owner. Currently, the process of applying and being matched with a suitable MAAD takes a minimum of 18 months. During training, the MAAD lives with 'foster families' who socialize the dogs from a young age and bring them to training sessions both at the training center and at other sites in the community, such as retail centers or other places where a paired client might visit with the fully-trained dog.

The other aspect of the charity's work, and the area engaged with in this thesis, is the training of Bio-Detection Dogs (BDD) to detect the odor of diseases, such as cancer, in samples acquired from collaborating hospitals, brought into the training center and presented to the dog under controlled conditions. Thus, unlike the MAAD, the BDD is never trained to find the odour of diseases on a person. Throughout the course of a BDD's career (variable but around five years), the dog lives with a local foster family who transports the dog to and from the training center around four days per week, dependent on the individual dog's training program.

MDD does not receive any government funding and is supported by donations from the public, and grants from charitable trusts, philanthropists and foundations. For instance, the charity's research into the detection of malaria—conducted using socks worn by children infected with the malaria parasite —was funded by a grant awarded to the project's Principal Investigator based at Durham University by the Bill and Melinda Gates Foundation.

MDD is the only organisation in the UK where research surrounding canine detection of human disease is being conducted. Therefore, gaining access to this site was critical to the viability of this study. Through contact with her personal assistant, in 2016 I arranged to meet with Dr. Claire Guest, CEO and co-founder of the charity, on a spring morning at the charity's offices in rural Buckinghamshire. Entering Claire's office, through a child safety gate—one of many fitted throughout the office to prevent dogs from wandering—I was first greeted by Claire's three dogs who rubbed their muzzles into the hand I offered to them. Pressing their noses onto my trousers as they sniffed, their saliva marked the smart slacks I had worn for the occasion. This feature of my clothing, adorned with the traces of inquisitive dogs, was something that I soon became accustomed to in the field. Claire stood up from behind her desk and reached out her hand to mine as she introduced herself. I sat on the sofa opposite her desk, joined by one of the dogs who, in keeping with the others, curled up and slept during our meeting. As we talked, my eyes were drawn to walls of the room that brimmed with pride and passion, featuring framed photographs of Claire's dogs (past and present), photographs of the charity's dogs posing in their official coats, a graduation photograph of Claire and various framed newspaper clippings documenting the charity's work.

I explained the background to my research, the questions I wanted to explore through my project and how I would go about doing this at MDD. Claire seemed genuinely interested in my work: a psychologist by training, we shared a common interest in human–animal relationships. She did however raise concern about how the charity might be represented in my work, as well as a worry about my presence being a potential distraction to the trainers. Owing to the largely open-ended nature of anthropological study, I was unable to give her what I felt would satisfy her: in short, any guarantees about the insights I would develop. However, I handed her an abridged copy of my master's dissertation to give her a sense of what my previous work looks like. As an organisation that relies on public donations and has faced skepticisim surrounding its work[11], image is critical and I could certainly appreciate her concerns. In most other field work situations, where the field site is anonymized, worries about representation are easier to appease. However, as the only organisation of its kind in the UK, offering full anonymity in this case would not be possible.[12]

[11] See chapter 3.

[12] Informant anonymity is discussed in the final section of this chapter.

A few days after our meeting, I received an email confirming that the charity would permit me to conduct my research about and with them, subject to an agreement that I would share draft publications emerging from this work (where the charity's actions are under analysis) with the charity's scientific advisor, for her review, prior to publication. Given that I could not offer my participants anonymity, I agreed to this stipulation.

Split over two periods between 2016 and 2017, I spent a total of eight months at MDD. During this time, I was on-site four days per week, shadowing and assisting in the everyday practices of the dog-trainers. Due to each testing phase of the charity's research studies taking place after around six months of training, the vast majority of my observations were inevitably focused on the training process. I was however present for the testing period of a bacteria-detection study. The work conducted during this week of testing largely resembled everyday training at the centre and given the limited data that it was possible to collect during this timeframe, detailed analysis of this aspect of the work was not possible. However, this thesis focuses on the trainers' everyday attempts to assess the subjectivity and reliability of individual bio-detection dogs: a reflexive process that largely characterises the shape of dog-training in this context.

Whilst there were some changes to staff during my time in the field, for the most part the bio-detection department was comprised of four full-time dog trainers and two part-time trainers (four men and two women). During my first three-month stint, I cultivated a role for myself between laboratory-technician and dog-caretaker, helping to support the trainers in tasks that included: preparing samples, setting up equipment, recording training data, dog walking, and cleaning.

During the morning dog 'drop off' period, whilst the trainers would accompany dogs outside on toilet-trips, I quickly learned that I could be helpful by manning the office and keeping everybody—humans *and* dogs—hydrated:

Looking out from a window inside the office, across the green fields that surround the charity's headquarters, I spot a flock of birds lined up along the electricity pylon wires and hear the faint sound of a tractor ploughing a field in the distance. I have just made tea for Alexa, Ed and Louise—the three dog-trainers here this morning—who are still outside walking dogs in the paddock. For the next couple of minutes, it is just myself, Meg and Maddie in the office: two black Cocker Spaniels. Meg doesn't pay me much attention,

remaining curled up on a foam dog-bed underneath Alexa's desk. Maddie however, appears keen to be close to me at all times, following me as I walk through the office and nuzzling her chin into my leg when I take a seat. Even when I am not looking at her, I sense her eyes fixed on me as I potter about the office trying to make myself useful, filling up bowls with fresh water for the dogs.

Keen to get involved wherever possible, I also often helped with tasks that one might consider 'dirty work':

Alexa returns from the paddock with Rolo and Ellie at the ends of the leashes in his hands. "Fox poo," she exclaims, "Again!" I turn to face her and see Rolo, a nine-month-old yellow Labrador, brandishing a large brown patch on one of his sides. My nose quickly registers the stench and I tell Alexa that I will grab the shampoo and a towel and meet her outside by the tap. Although I have only been here a week, I already know the drill. As I make my way outside, I see Alexa using the hose to rinse Rolo. With surgical gloves on to protect my skin from the offending muck, I lather shampoo into Rolo's dirty fur. After another rinse, Rolo shakes his entire body, showering myself and Alexa with water. Alexa wraps the towel over Rolo, rubbing his body from muzzle to paw.

Gradually, I was entrusted with greater responsibility, as I was soon walking dogs unsupervised. Eventually, I was offered the chance to handle dogs during training searches, which I did routinely during the latter period of time spent here. Fulfilling this role enabled me to not only observe, but to meaningfully participate in the everyday training and care of the dogs. Outside of the MDD headquarters, I attended two working-dog conferences with the trainers who were always willing and keen to share their knowledge and perspectives with me.

As neither employee nor conventional volunteer, there were occasions where my liminality left me feeling betwixt and between roles. In many ways, my role as external researcher put me in a position of privilege, as I did not have the same responsibilities as an employee yet I was still able to enjoy the opportunity to work closely with the animals. However, enjoying being so involved with the training (i.e., the *participatory* aspect of my research) caused me to, on occasion, momentarily lose sight of what I was fundamentally

there to achieve. It is easy to account for those days in my field diary, as my notes are significantly scanter than usual.

Penn Vet Working Dog Center (Philadelphia, USA)

The city of Philadelphia in the United States of America, some 35,000 miles away from MDD, is home to my second field site, the *Penn Vet Working Dog Center* (PVWDC): a research and development facility that is part of the University of Pennsylvania's School of Veterinary Medicine. The vet school is funded by a combination of state and federal funding, tuition fees and private donations. PVWDC train and conduct research with dogs in three primary areas: law enforcement (e.g., explosives, drugs, and apprehending human suspects), search and rescue (of both live and deceased persons), and cancer-detection. The organisation's research is aimed at optimising the performance, health, and welfare of detection dogs. In addition to their formal training and participation in research studies, the dogs also take part in regular agility sessions, conducted to provide what the trainers conceptualize as the dog's enjoyment, in addition to supporting their physical and mental health. Thus, whilst the everyday work and short- and long-term aims differ in some regards from MDD, the two organisations share a commitment to training detection dogs and conducting studies to develop research in this field.

This broad mutual endeavor, and the more specific common interest in training dogs to detect the odour of human disease fosters a degree of cooperation between the organisations. Opportunity for formal knowledge sharing includes the annual working dog conference hosted by PVWDC. At the 2016 event, for instance, the Directors of MDD and PVWDC each gave presentations detailing recent research findings not yet published. The organisations also assist each other through more informal means. For instance, whilst I was conducting fieldwork at PVWDC, I sat alongside Angela and Sue, the Training Director and Manager respectively, as they video-called Simon, senior trainer at MDD, to discuss equipment. Angela and Sue were curious to learn about MDD's training set-up, with a view to upgrading PVWDC's training apparatus—especially the steel carousel structure on which the odour samples are presented to the dogs. During the call, Simon filmed as a dog searched the carousel, and he highlighted the equipment's specific design features, such as its detachable arms that make it highly portable for conducting off-site demonstrations.

Negotiating access to this field site was relatively straight forward. In April 2016, I attended a working dog conference in Philadelphia hosted by PVWDC. In the months

leading to the event I had been in email contact with Dr. Cynthia Otto, PVWDC's Executive Director, to express my interest in the center's work and my desire to conduct research with them. She was quick to reply and suggested we meet at the conference. In between presentations—on topics ranging from search dog stress during helicopter transportation, to the use of sensory equipment to measure dog's olfactory behaviour during cancer detection (presented by MDD CEO, Dr. Claire Guest)—I introduced myself to Cynthia at the table where she was sat, and I told her a little more about my research. She told me I would be welcome to conduct research at the center, where I could join the team as an intern for the duration of my fieldwork. Over the subsequent eight months, Cynthia provided immense practical support via email during the arduous process of arranging my visa. She also helped me to find accommodation in Philadelphia, with some veterinary students from Pennsylvania University where she lectures.

In addition to the traditional paper presentations, the 2016 conference also offered delegates the opportunity for a guided tour of the working dog center. This was my first visit to what would be my US field site and provided me with a deeper understanding of the distinction between my two field sites, with this organisation's roots and purpose being fundamentally entangled with to a drive to protect national security. This character of PVWDC is visible on entrance to the main training room, where an American flag is visible on the far wall. Next to this, is a framed portrait of a yellow Labrador wearing a police badge, with the twin towers and an American flag in the background. I have to get up close to the artwork to read that it is titled '*Salute to Sirius*' and is accompanied with a handwritten note that reads, '*Sirius, You gave your life so I may save others*'. This portrait memorializes Sirius, a police dog who died in the attacks on the United States on September 11th, 2001.[13]

[13] On the morning of September 11th, 2001, Port Authority Police Sergeant David Lim and Sirius, the yellow Labrador retriever in the painting, were in their South Tower basement office when the first plane hit the North Tower. Upon hearing the commotion, Officer Lim put Sirius in his kennel and told him 'I'll be back for you' as he went to help at the damaged tower. Before Lim could return to Sirius however, the South Tower collapsed followed by the North Tower. Lim was safely rescued later that day. Several months later, in January 2002, Sirius' remains were uncovered in his kennel. At a memorial service held for Sirius, four-hundred people attended including one hundred service dog teams from across the country.

The events of 9/11 were a catalyst in the establishment of this facility. For ten days following the attacks, Cynthia—a university professor and veterinarian specializing in Emergency Medicine—was deployed to Ground Zero as a support specialist with the Pennsylvania Federal Emergency Management Agency Urban Search and Rescue Task Force. During the search and rescue operation, she was responsible for supervising the search dog's care. Inspired by the courage and commitment of the dogs and their handlers, and concerned about the limits and gaps in the knowledge about working dogs among those in the veterinary community,[14] Cynthia was keen to develop knowledge and skills among veterinarians and dog-handlers in this field.

First, she conducted a study of the search and rescue dogs who were deployed at Ground Zero to examine whether the conditions they were exposed to had any long-term impacts on their health (Otto et al., 2012). Compared to a control group, the findings included mild changes in blood work and a higher incidence of radiographic cardiac abnormalities of deployed dogs. Keen to have a greater impact on the field however, Cynthia eventually secured the funding and premises from which to officially open the PVWDC on September 11th, 2012. As I later heard Cynthia herself assert, "We're the legacy of 9/11."

In addition to items such as the portrait of Sirius, this legacy is also implicit in the center's puppy naming process. Puppies who are enrolled in the training programme here are named after dogs who were deployed in the 9/11 search and rescue mission. This naming practice arguably helps their human caretakers to navigate the boundaries between past and future. Indeed, describing the immediate need, in the aftermath of 9/11, to compile a list of the names of the victims, Barbara Bodenhorn and Gabrielle vom Bruck (2009, 2) note the association between the recitation of names and the act of remembering, arguing that 'the recitation of names is a crucial aspect of memory, an active not-forgetting, that validates the present order more often than not, bringing the political aspect into view'.

[14] During an interview, Cynthia told me that her concerns included: the lack of guidelines in place for monitoring and optimizing the dogs' health and welfare; the absence of personal protective equipment available for the dogs, despite this being worn by their handlers, and; the potential for the overworking of dogs due to their handlers' desires to find survivors before it would be too late.

PVWDC's dog-trainers—six women and one man[15]—are supported by a team of voluntary staff: a mixture of volunteers, who come to the center as and when they can in their spare time, and student interns with set hours. This unpaid workforce comprises the majority of the people who collect, organize, and sometimes also help to analyse the data that is gathered during training and research activities. Many of the interns are local university students who spend six months interning at the center as one of their 'cooperative' work rotations that comprise part of their degree structure. Therefore, my presence akin to a student intern—of sorts—was not out of place. Furthermore, PVWDC collaborates on research projects with external individuals and institutions, both nationally and internationally, so they are experienced in having other researchers keen to learn with and about them and their work.

I always felt warmly accepted into the PVWDC community as the team encourage and support all their voluntary workers to get involved in the various aspects of daily work. However, it was only when my time at the center was coming to an end that I got an insight into what my informants thought about my presence and the nature of my research. On my last day, as I was saying goodbye to Sara, one of the trainers, she said to me:

> "You know, whilst driving into work this morning I was thinking back to your first day. When you first came in and told us you were here to do research, I thought 'Oh no, not another one'! But now I'll be really sad to see you go. You've got so involved, I don't know what we'll do without you."

[15] Despite the high proportion of female to male dog trainers at PVWDC, the gender breakdown of animal trainers more broadly, across the USA, is not estimated to be as significant. In 2016 women comprised 54.5% of the workforce. What is significant however, is the rate at which the percentage of women in the occupation of animal training has grown in the USA. In 2000, women made up just 40.6% of animal trainers, whereas today they outnumber men in this profession (US Census Bureau: https://datausa.io/profile/soc/392011/#demographics).

Although academic research exploring the recent increase of the share of women in animal training is scant, I propose that this may be associated with the shift in animal training methods, which I discuss in chapter 4. Whilst methods of force and relationships based on human dominance characterized animal training for much of the twentieth century, today the emphasis is on building empathetic relationships with the individual animal being trained. If women are more affectively empathetic than men, at least among Euro-Americans, as Claudia Strauss (2004) has argued, then this may help account for why contemporary practices of animal training are attracting a greater share of women.

At PVWDC, all interns and volunteers are assigned to work with one of the trainers. I was allocated to Jen, a woman in her early forties, dressed in cargo pants and walking boots, with long blonde hair which she would tie up just before working with a dog. While learning the ropes, most of the work tasked to interns and volunteers involves supporting the trainer by recording data. This involves either observing training and completing data sheets by hand, or video recording the session. In order to be assigned to more hands-on tasks, responsibility must be earned by the volunteers who have to prove their willingness to listen, learn and follow the center's rules and processes.

For example, one of the first activities all volunteers learn to participate in is 'potty walking' (i.e. taking dogs outside to go to the toilet). In their first few weeks, volunteers shadow other, more experienced, volunteers or trainers during frequent potty walks in order to learn the process that is followed for this activity. In order to take a dog out for a walk without supervision, every volunteer has to first shadow, then practice this activity with someone more experienced, before undergoing an assessment with their trainer. Only when Jen was satisfied with my ability to follow the center's potty walk procedure, was I cleared to undertake this task alone. This process involves prompting the dog to sit in his kennel (using either a verbal "sit" command, or a hand gesture in which one raises an up-facing palm), opening the kennel door and attaching a leash to the dog's collar, giving the dog the command to walk out from his kennel and practising loose-leash walking (described in detail in chapter 4) whilst out with the dog. Maintaining consistency in mundane practices such as potty walking is considered fundamental to teaching the dogs how to behave and, thus, to developing the ideal detection dog. I was cleared to potty walk alone three weeks after my arrival. Being able to walk dogs unsupervised opened up a new arena in which I could participate in the everyday activities, without requiring the direction or supervision of Jen. This responsibility made me feel less of a spare part and more like I was able to contribute something, especially when Jen was busy or off-site. After all, with an excess of twenty dogs in the center each day, there was always a dog who could benefit from a toilet trip and some fresh air.

From the outset, there was plenty of opportunity for me to get hands-on in a range of tasks besides potty-walking. Jen encouraged my participation, inviting me to film or record data for training sessions. She also guided me on how to handle dogs in the various components of the center's canine fitness programme. For example, I learnt how to encourage dogs onto the treadmill, using positive reinforcement. Eventually, I was also

given the chance to handle dogs during scent-detection training sessions. Whilst no aspect of the center's work was "off limits" to me, due to unforeseen logistical circumstances I was unable to observe any testing phases during my three months there. Throughout the duration of my fieldwork at the center, the team endured an unexpected delay in the procurement and delivery of samples (blood plasma) from their collaborating medical institution which rendered them unable to train with the target substance or conduct any research trials in this time. Thus, the cancer-detection dogs I observed in training at PVWDC were being trained to find an artificially-made training odour in order to "keep their brains going," as it was put to me by Sebastian—the center's Postdoctoral Fellow, who oversees the day-to-day running of the center's research projects.

Due to the aforementioned practicalities—the finite length of time I had to conduct fieldwork, combined with the working routine of my field sites and the unforeseen sample hold-up at PVWDC—the analysis presented in this thesis focuses predominantly on the training dimension of bio-detection work.

ii. Methodology

a. Research Methods

My primary research methods consisted of participant observation and semi-structured interviews.

Participant observation

At both sites, as alluded to above, I was very active in the day-to-day activities of training and caring for the dogs. Initially I was tasked with the more mundane tasks of walking and grooming dogs, but my responsibilities quickly developed as I became more embedded in the respective teams. Learning and practicing dog handling myself was invaluable in developing my understanding of the embodied nature of the communicative work being conducted between the species here.

Throughout each day I jotted down observations and comments made by my informants in a small notebook, which I kept on my person. Each night I made these notes more detailed as I typed them up. With permission from my informants, I also used my phone to take photographs and make audio and video recordings which I later transcribed.

Interviews

I conducted interviews at both sites, drawing on pre-formulated semi-structured questions, split into several thematic areas. Each interview took between twenty-five and sixty minutes and with permission I made audio recordings of these conversations, enabling me to produce transcriptions. The interviews took place in research offices at the respective field sites. During my first period at MDD I conducted a group interview as well as one-on-one interviews with individual trainers. During my second period there, I interviewed some of the same individuals again, in addition to interviewing the newer staff who had not been employed during my initial stint. At PVWDC I conducted interviews with nine people: the center's Director, four trainers, the Post-Doctoral Fellow, and three student interns.

b. Researching in Field Sites Beyond-the-Human: Incorporating Animals into Ethnography

Throughout my research I have understood my informants as comprising not only the human trainers, research staff, and volunteers but also the detection dogs and those in training. Although incorporating dogs into my research has presented methodological challenges, these have not been insurmountable.

As the study of 'mankind', anthropology has long restricted the subjects of its study to beings of the human category, setting humanity apart and above from nature (Ingold 1990). Where animals are present in twentieth-century anthropological research, they appear typically as raw material for human action or thoughts (Noske 1993), rather than as social actors in their own right. In the last two decades however, the role of animals in ethnography has rapidly shifted.

In particular, there have been growing calls for the expansion of the discipline to incorporate nonhuman beings as participants in ethnographic research (e.g., Paxon 2008; Raffles 2010; Tsing 2009), where animals' 'lives and deaths are linked to human social worlds' (Kirksey and Helmreich 2010, 545). Towards this end, Kohn (2007, 4), proposes an 'anthropology of life', that 'questions the privileged ontological status of humans as knowers' and epitomizes 'an anthropology that is not just confined to the human but is concerned with the effects of our entanglements with other kinds of living selves'. The body of literature within which this position has advanced, consolidated with the term

'multispecies ethnography' (Kirksey and Helmreich 2010)[16], raises methodological and epistemological questions that demand reflection from those conducting research under this rubric. Most fundamentally, can we achieve sufficient interspecific understanding with animals and incorporate them into our ethnographic practice, and if so, how?

Arguably the most obvious challenge to consider concerns the fundamental differences in species-specific communication modalities. Of course, human and nonhuman animals do not communicate using a shared verbal language. Furthermore, anatomical differences make it physically impossible for humans to wholly adopt other animal's modes of communication. Certainly then, it requires greater effort to attend to one's nonhuman participants and, in the absence of a shared language, the possibility of conducting interviews to clarify our understandings of our informants is precluded, forcing us to rethink how we can reliably make sense of their experiences.

However, whilst animals do not share the human capacity for verbal language, they are certainly not mute and I argue that is possible to achieve a reasonable degree of intersubjective understanding. To achieve this, requires paying attention to the somatic sensibilities of the individual animals whose experiences we seek to understand, made sense of alongside a basic zoological knowledge of the particular species in question.

A brief look at some ethnography that incorporates animals can help to illustrate this position. David Goode (2007, 89) makes the point that 'more can be and is communicated than can ever be codified into language'. This assertion is made in Goode's autoethnography *Playing with My Dog Katie* (Ibid.), in which he illustrates that achieving intersubjectivity with his dog necessitates paying careful attention to mundane routines and tactile and embodied actions. Indeed, whilst dogs obviously cannot talk, 'dogs are skilled intentional communicators…dogs are adept users of body language…through body postures, and movement of their eyes, ears, tails, and mouths' (Arluke and Sanders 1993, 133). Goode notes that such embodied communication is expressed by humans too, for in the company of Katie he experiences his body not only for himself, but also as a body for Katie. Goode's ability to make sense of the play interactions between himself and Katie—to read and develop an understanding of both bodies—emerges as a process of learning,

[16] Refer to chapter 1 for an overview of 'multispecies ethnography'.

dependent on his knowledge of the particular histories that their play has subsumed over time.

To understand human–cat interactions, Janet and Steven Alger (2003) have focused on the nonlinguistic habitual routines that lead to an intersubjectivity that is achieved through shared communicative interpretations. In their study of the routine interactions between and among humans and cats in a New York cat shelter, they contend that cats communicate with humans through the same symbols used by humans. For instance, they note that cats often interpret a human slapping his leg when seated as an offer to sit in his lap.

Despite the absence of a shared verbal language, it is clearly possible to communicate with animals in a way that enables the production of shared understanding that can be interpreted ethnographically. Attention to the nonverbal emerges as fundamental, and this is something anthropologists are trained to attend to; for even among humans, a significant proportion of communication is non-verbal (Mehrabian 1972). After all, participant observation—the method par excellence for most ethnographers—does not only demand the ethnographer focuses on the verbal, but also the somatic.

It thus follows that the ethnographer's body becomes her principal tool, which she employs to achieve an understanding of the group in question (LeCompte and Schensul 1999, 1). Indeed, I not only considered non-verbal communication important among my canine informants, but also among the humans. Thus, in addition to penning down notes referring to conversations, I also watched and felt the kinesthetic elements that comprise the human–dog relations discussed in this thesis.

Employing my body 'as a tool' in the field was critical to this project, especially given that the techniques of dog-training practiced by my informants[17] are based on exercises performed at the interface of the bodies of human and dog. Gradually, as a result of watching other human–dog dyads and practicing myself with various dogs, I learned new skilled bodily practices—novel ways of moving and monitoring my body—that enabled me to communicate successfully with the dogs.

Learning this new body knowledge was a messy process however, comprised of many failed attempts at communication. For instance, during an outdoor agility training session at PVWDC, with trainer Jen and Springer Spaniel Murphy, I was alerted to the

[17] See chapter 4 for an outline of the training methods.

necessity of clear bodily gestures when attempting to foster a shared understanding with the dogs. Jen offered me the opportunity to guide Murphy through an agility routine that included climbing frames, ladders and tunnels. To begin, as is customary, I asked Murphy to sit. I then pointed an arm in the direction of the first obstacle, a tunnel, and called out, "tunnel." Instead of running through the tunnel however, Murphy completed a different obstacle adjacent to the tunnel I thought I had been pointing to. Having watched our misunderstanding occur, Jen suggested that next time, before prompting Murphy to begin, I should direct Murphy closer to the start of the tunnel, as otherwise his vision is conflicted between the two obstacles in front of him.

Skilled bodily practices, that involved me becoming increasingly attentive to the dog's nonverbal utterances and needs, were thus an important element of my participant observation in my multispecies field sites. In this process, in keeping with the practices of many contemporary dog-trainers who demonstrate sensitivity towards the species-specific experience of an animal (Wlodarczyk 2017; 2018), I learned to become 'more dog' (Ibid.).

The notion of one's body as a tool is also explicit in Goode's work (2007) and can help researchers foster an understanding of the world through the eyes of the animals. Building on Malinowski's (1922) call to see the world through the eyes of the 'natives', both Marc Bekoff (2002) and Arluke and Sanders (1993) consider this mode of seeing the world a prerequisite for researchers of human–animal relations.

For Arluke and Sanders (Ibid., 378), it is 'the researcher's disciplined attention to his or her emotional experience [that] can serve as an invaluable source of understanding'. According to Kirsten Hastrup (2004), it is this experience—namely, the *performative* mode of knowing—as opposed to 'facts' or 'data' that is central to the evidence that shapes anthropological knowledge. It is through 'living the character' (Hastrup 2004, 465), that the anthropologist comes to understand the ways in which particular modes of action come to be taken for granted. For example, in the Khangai Mountians of Mongolia, Natasha Fijn (2011) played her 'part' (Hastrup 2004) living with a group of herders and herd animals (yaks, cattle, horses, sheep, and goats) in their encampment, participating in the same tasks, and thus actively interacting with both herders and herd animals. As a result, Fijn gained a gradual accumulation of embodied knowledge that allowed her to communicate reciprocally with the animals and learn experientially about the relations between Mongolian herders and herd animals. When playing the role of milkmaid, it took several sessions before the cows became comfortable in Fijn's presence, due to the novel scent

she carried. To help calm the cows, Fijn wore the same jacket during every milking session; this jacket was rarely washed and thus became imbued with the scent of the herd. Through such attention to the cows' 'umwelt' (von Uexkull 1957 [1934]), or lifeworld, as well as actively playing the role of the herders, Fijn developed a perception of a 'multispecies universe' (Fijn 2011, 39). Fijn's training in ethology arguably places her in a privileged position from which to pay attention to the animals. However, the understanding she develops is clearly heavily dependent on the method of participant observation and points to the potential of such a process for enabling the researcher to see the world, at least to a greater extent than they had before, through the animal's eyes.

Meanwhile, other scholars are less optimistic about the suggestion that animal experience can be shared by humans. For instance, Thomas Nagel (1974) claims that humans can never know what it is like for a bat to be a bat, only what it might be like for a human to be a bat. Adopting a similar position, Gary Fine (2004, 642) argues that in the Alger's (2003) study of humans and cats, the researchers 'read volunteers from the inside out and cats from the outside in'. At the heart of such arguments are concerns regarding anthropomorphism: the attribution of human mental states (thoughts, feelings, motivations and beliefs) to nonhumans, condemned as 'that worst of ethological sins' (Masson and McCarthy 1996, 9). Described by Cary Wolfe (2003, xii) as 'one of the central ironies of animal rights philosophy', anthropomorphism is one of the key critiques to emerge from the expansion of ethnographic enquiry to include animal subjects. Critics condemn the use of human terms of representation to account for the experience and behaviour of animal subjects.

An alternative mode of interpreting animals, that adopts a reflexive position in response to the critiques of anthropomorphism, is available in what some refer to as 'critical anthropomorphism' (Morton et al. 1990). Proponents of critical anthropomorphism draw on a combination of their 'intuitions about what is best for an animal, based on a knowledge of ourselves and other people', but 'tempered by objective knowledge of the particular species' (or individual animal's) life history, behaviour, and physiology (Morton et al. 1990, 1). The analysis offered in this thesis, is aligned with a critical anthropomorphism standpoint, as I develop my understanding of the dog's actions and lives with reference to developments in the field of canine cognitive science. Adopting an approach that crosses disciplinary boundaries aligns my work with a body of multispecies scholarship that has attempted to transcend the discrete methodological and theoretical domains through which the social and natural sciences traditionally operate

(Fuentes 2012; Locke 2013). Such interdisciplinary research programs reflect sentiments about the inadequacies of ethnography as a methodology, underpinned by a humanist epistemology, for incorporating nonhuman life. Through Baynes-Rock's (2015) work, that elucidates the relations between humans and hyenas in the Ethiopian city of Harar, where the bone scavenging hyenas dwell alongside urban human inhabitants, we see how a methodological approach that is informed by both human ethnography and animal ethology can advance understandings of human–animal relations. Similarly, though realized not at the outset of fieldwork but during the process of writing-up, Piers Locke (2013; 2017) recognized the relevance that developments in the fields of cognitive and behavioral animal sciences could have for aiding his understanding of elephant lives and interspecies relations in his ethnographic study of the intimacy of human–elephant encounters in Nepal. Arguing for the productive potential of such an approach, Locke (2015) notes, that although as anthropologists we 'may theoretically recognize the hybrid entanglements of humans and other species, with few exceptions our framework and methodology remains thoroughly non-hybrid.'

Nevertheless, while emphasizing the productive potential of integrating material and research practices from the cognitive and behavioral sciences to enrich an otherwise largely humanist ethnography, Locke (2015) remains mindful of the question of epistemological incommensurability that might be raised in response to research frameworks that depend on the integration of interdisciplinary research traditions. To allay such concerns, he highlights various cases in which ethnographic practice has been integrated with other methodological perspectives, particularly ethological approaches (e.g. Baynes-Rock 2015), with productive consequences. Illustrating how ethological methodologies have sometimes harnessed an approach akin to the ethnographic, he draws on Despret's (2013) insight that ethological research has not necessarily been strictly observational as it is often claimed. For instance, Lorenz's practice of becoming 'parent' to the baby jackdaw who had attached herself to him reveals how ethologists have permitted themselves to be incorporated into the social worlds of the animals they study.

Emerging from such work are new syntheses that emphasize the subjectivity and agency of organisms whose lives are entangled with human existence (Kirksey and Helmreich 2010). The development of sub-disciplines in the multispecies body of scholarship, such as ethnoprimatology, have been recognized as affording potential for the 'reconciliation of biological and social anthropology' (Riley 2006, 75). The work presented here does not attempt such a radical challenge to the methodological or

epistemological approach to anthropology as that of ethnoprimatologists (e.g. Fuentes 2012). Nevertheless, incorporating insights from the domain of canine cognitive science (e.g. page 107), this work shares broad concerns and perspectives with the work of multispecies anthropologists exploring the productive possibilities of blurring the disciplinary practices of ethnography and ethology.

The evidence I borrow from ethology, for instance with regards to how dogs have evolved to read the behaviour of humans, highlights biosocial preconditions for how dogs and humans 'learn to pay attention to each other in a way that changes who and what they become together' (2008, 208). This work thus mobilises anthropology by emphasizing entanglements across species. We learn that animals are not only looked at but they look back too; a recognition that demands a rethinking of how interspecies interactions might be explored within a traditionally humanist doctrine.

In this thesis, incorporating recent developments from ethology is not only helpful for building a richer understanding of the dog's actions and lives but also those of the trainers, as it is within this wider context of animal behaviour science that they approach their training practices. However, my perception of the evidence presented by ethologists is not of transparent truth, but of 'situated knowledge' (Haraway 1988; 1991) that is reflective of larger ideological projects. As Justyna Wlodarczyk (2018) notes, dog training practices throughout history have mirrored whatever the prevalent scientific discourse of the period tended to be. Over time, canine science has changed and will continue to change, shaping methods of dog training in the process. For Haraway, the contexts of interaction, the ideas, priorities and perceptions of the people involved in producing knowledge, as one possible interpretation of reality, matter. Thus, I remain cognizant to the partiality of knowledge from all epistemological approaches incorporated here.

Incorporating animals into ethnographic research also obliges the researcher to make decisions with regards to the written representation of animals. In my writing, when I refer to a specific dog, I do so with reference to the individual dog's name[18], loyal to the practices within my field sites. Adopting such a practice reflects how the dogs are understood—by both my human and canine informants—as individuals with feelings and distinct personalities. The importance of preserving such individuality will become clear

[18] Pseudonyms for dog names are used to maintain anonymity of dog trainers. See section below on informant anonymity.

throughout this thesis as an essential attribute of each dog and a notion that shapes human–dog relations and how interspecies training and work is 'done' in these contexts.

Such choices concerning representation bring me closer towards a non-anthropocentric methodology, where the individuality and agency of the animals is acknowledged and incorporated into my analysis. Here, I follow other scholars including Fijn (2011) who, instead of trying to understand the Mongolian herding community from a perspective in which the herdsmen and women are strictly dominant over their animals, acknowledges the agency of the herd animals and the influence they have upon Mongolian herders' lives, and incorporates them into her ethnography. This results in a representation of the community in which the herders themselves are central, but which paints human–animal relationships as being co-dependent and characterized by a two-way flow of communication.

In sum, the ethnographic method, with its attention to the more-than-verbal, offers potential for generating insight into the lives of animals and the intricacies of their relations with humans. Arguably, this is especially applicable for domesticated or 'companion' animals, who share a long history of interspecific communication with humans. Taken together, the literature reviewed in this section suggests that, alongside an ongoing reflexive standpoint, concerning animal interpretation and the potential dangers of naïve anthropomorphism, it is certainly possible to incorporate individual animals into the ethnographic endeavor.

During my time in the field I made a considered effort to pay attention to both partners of the human–dog dyads I encountered, dedicating space in my field notes to exploring what the dogs were doing as well as the humans. In particular, this included individual dogs', gestures, sounds, and interactions with humans or other dogs. Video-recording routine activities, such as training sessions, enabled me to produce more detailed analyses of movements and interaction. The method of video-recording, used in conjunction with participant observation, has been employed by many multispecies anthropologists (e.g. Lauerier et al. 2006; Fijn 2011) as a method that does not privilege verbal language.

iii. Ethics

a. Informant Anonymity

Given the niche nature of the work my informants are engaged in, I was unable to guarantee my informants total anonymity within this thesis and associated publications. The crux of this difficulty lies in the fact that globally there are very few organisations conducting the specific field of work that my thesis explores.

Although anonymity of the organisations was not possible, I have nevertheless taken steps to reduce the potential for individual informants to be easily identifiable. Most notably, I use pseudonyms throughout; not only for the humans but for the dogs too, given that dogs can easily be linked to individual trainers since each dog is assigned to a particular trainer with whom they interact most frequently. The only names that are not anonymized in this thesis are those of the organisations and their respective Chief Executive Officer and Director. This decision was made due to the ready availability with which this information is available in the public domain and my desire to include information about their respective publications in their fields of research.

Despite being unable to assure full anonymity, I do not believe my work to put my informants at risk of harm. The work they are involved in is neither illegal nor socially problematic. Informants were made aware of this circumstance in information sheets and in personal discussion before making their decision of whether to consent to participate in this research.

b. Researching in Field Sites Beyond-The-Human: The Invisibility of Animal Informants in the Ethics Review Process

As I completed my department's mandatory ethics review application before heading to the field, I did not consider my research to be of significant ethical concern. On reflection however, the ethical review process failed to account for the most vulnerable beings in my research: the dogs. Echoing Rosemary-Clare Collard (2015), this points to the human–animal dualism implicit in the ethics review process: a process that demands critical re-thinking. Given the rapid and continued surge of interest surrounding the animal turn across the social sciences and humanities, such discussion is pressing.

In the process of seeking ethical approval for my research, the animals were notably absent. The list of 'vulnerable populations' to consider in my department's ethics form includes only human categories: specifically, 'children, prisoners, mental patients or any

other groups that would be considered at risk'. Under the imperative of the human–animal dualism, in which humans are considered separate from other animals, animals are deemed outside the scope of this ethics review process. Where, then, might there be space for ethical deliberation regarding animals?

An obvious place to look to is the field of Animal Research: namely, the experimental research using animals, often in medical studies. As part of an initiative to ensure high levels of welfare and prevent 'unnecessary' harm to the animals involved, researchers intending to conduct experiments using animals must (rightly so) confront a whole host of bureaucratic hurdles in their ethical review process.[19] Here, the ethical obligations towards the animal as research subject are clearly considered. Nevertheless, by framing the animal a distinct category in its own right, in this process the animal is reproduced as the normative subject of a particular mode of experimental research with rules and regulations that differ to those surrounding research with human subjects. Thus, the category of the animal as separate and subordinate to the human is reproduced in both ethics review processes outlined.

Whilst I did not conduct experiments on animals—a fact which exempted me from the need for Animal Research ethics approval—my fieldwork nevertheless led me into direct and prolonged contact with animals. There were occasions when I was temporarily left alone with a dog or multiple dogs. In order to maintain their high standards of animal welfare, my human informants gave me training in their processes for husbandry and exercising practices. However, such high welfare standards and training for researchers are far from universal in other human–animal spaces, thus potentially leaving many animals at risk of harm.

In sum, neither of the ethics review processes briefly outlined above are apt to meaningfully deliberate the ethical implications that can be associated with multispecies ethnographic fieldwork. While I do not suggest that the dogs with whom I worked alongside were at risk of harm from my presence, I do contend that with the continuing upsurge of interest in multispecies ethnography and increasing numbers of anthropologists likely to come into direct proximity with animals in the field, there is a critical need for

[19] According to UCL's Animal Research Ethics guidelines, researchers must work toward the principle of the '3Rs': Replace, Reduce, and Refine. In the UK, 'Animal Research' is covered in legislation (The Animals (Scientific Procedures) Act 1986).

discussion about the potential vulnerability of animals and how we can make space for these research practices to be effectively deliberated within the ethical review framework.

Chapter 3. Introducing Bio-Detection Dogs

This chapter outlines several essential aspects of the practice of bio-detection dogs in order to equip the reader with the necessary context to frame the forthcoming discussions presented in this thesis. In particular, this chapter details how the notion of dogs detecting human disease transformed from a compilation of anecdotal stories into an area of scientific research. Here, I also introduce the spaces and methods through which this work is conducted and detail the particular manner in which bio-detection dogs are cared for. Taken together, these discussions highlight how bio-detection dogs are distinct from other categories of detection dogs and assistance dogs.

i. The Emergence of Bio-Detection Dogs: From Anecdote to Fact

Although the bio-detection dogs that this thesis focuses on are not currently being used operationally in the clinical diagnosis procedure, in several ways their work is nevertheless tied to the lives of many patients of the diseases they are trained to detect. Most significantly, we can consider those people who provide biological samples for the dogs' training. Whilst strict data protection rules surrounding the patients who donate these samples mean the experiences and perspectives of these people are largely absent from my data, by turning to the anecdotal stories about pet dogs spontaneously alerting their owners to their cancer prior to a clinical diagnosis, it is possible to get a sense of how these dogs are perceived by those people who have experienced first-hand the dogs' ability to detect the odour of disease. Exploring these anecdotes is also important in tracing the origins of this field of study.

Since the late 1980s, several anecdotes have been reported in the medical journal *The Lancet* regarding pet dogs purportedly detecting cancer in their human companions (Williams and Pembroke 1989; Church and Williams 2001). These reports, written by clinicians, detail similar stories. In the more recent case (Church and Williams 2001), the authors describe how a pet Labrador was persistently sniffing at a lesion on the thigh of her owner. The dog's constant interest in this area of the patient's leg prompted him to seek medical advice, and when the lesion was eventually excized and studied, it was discovered to be a basal cell carcinoma.

Prior to becoming aware of these reports in 2001, Claire Guest had been told an almost identical story by a friend, concerning her friend's dog and a mole on her friend's leg. As Claire recalls:

> "A friend of mine told me that her pet Dalmatian dog had sniffed and licked a mole on her calf persistently, to the point where she said it was a nuisance. She said this wasn't a passing interest; this was a dog that was fixed on this small mole on her calf. She said that if she walked past the dog, even if she had trousers or boots on, the dog's nose would twitch and it would come and find this mole. She said that over time, she started to become concerned about why this dog was showing such interest. She went to her GP and as the mole wasn't bleeding or itching the GP wasn't at all concerned. But [after some tests] he called back to tell her she had a malignant melanoma, the most serious form of skin cancer. I was absolutely fascinated by this story."

In 2001, by chance, Claire happened to hear John Church, a retired orthopedic surgeon, talk about these anecdotes on the radio, pleading for collaborators to help gather scientific evidence of the dog's ability to detect the odour of cancer. As a dog-trainer with over twenty years' experience and equipped with a degree in behavioural psychology, Claire felt compelled to make contact with him immediately. In collaboration with a team of researchers, Claire and John subsequently conducted a 'proof of principle' study that was published in the *British Medical Journal* and provided evidence that dogs can 'smell' cancer (Willis et al. 2004). This marked the beginning of the charity and Claire's career training dogs to detect cancers such as prostate and bladder cancer. However, it was not until several years later that Claire herself experienced first-hand the spontaneous disease-detecting capability of one of her dogs, Daisy.[20] In her memoir, *Daisy's Gift* (2016), Claire writes:

> Daisy stood in the boot, nudging my chest with her nose and staring up into my face intently with her big, brown eyes, forcing me to pay attention to her. 'Stop it, Daise', I said, 'C'mon, don't you want a run?'…Daisy was refusing to leave the boot and was still pushing her nose into my chest. It was very odd: she was normally as keen and energetic as the others. (197-8)

[20] Although Daisy had been trained by Claire and colleagues to detect the odours of bladder and prostate cancer, she had not undergone training to detect breast cancer.

In the above excerpt, Claire describes how, in a single moment, the ordinary activity of walking her dogs became extraordinary. After this encounter with Daisy, Claire noticed that her breast felt painful and she became aware of a small lump underneath her skin, prompting her to visit her doctor. Whilst this cyst was found to be harmless, a core biopsy revealed a small tumour, located deep in her breast. This required immediate surgery followed by a course of radiotherapy. Claire considers Daisy's odd behaviour that day a spontaneous alert and an illustration of their close relationship that Claire perceives ultimately saved her life: 'Daisy has always been one of my very special dogs. There is a deep understanding between us, and it is this bond that I believe saved my life' (Ibid.).

While the charity's aforementioned first study (Willis et al. 2004) was small, both in terms of sample numbers[21] and dogs tested (n = 6), they considered the results to be promising. The successful detection of urine samples from patients with bladder cancer was achieved 41% of the time: significantly greater than the 14% expected by chance alone. Here, it can be noted that in the official publications reporting on these studies, the bio-detection dog figures as a statistical unit that can be represented in graphs and compared against other dogs or other detection technologies.

Recalling the moment that these findings were published, during a talk to members of the public visiting the charity's headquarters, Claire remarks with excitement about the media interest that the study attracted: "It was announced all over the world. We had a lorry with the satellite come and sit outside where the dogs were working for two days. It made a massive story: cancer has an odour, a unique odour, and dogs can be trained to find it." As well as media interest, the publication sparked a burgeoning curiosity from scientists and dog-trainers around the world, with subsequent studies reporting on the detection of bladder (Leahy 2004; Welsh 2004), lung and breast (McCulloh et al. 2006), skin (Campbell et al. 2014) and ovarian (Hovarth et al. 2008; Hovarth et al. 2013) cancers, as well as infectious diseases (Bomers et al. 2012).

[21] In training, 27 positive urine samples and 54 control urine samples were used. In testing, 6 positive samples and 54 control samples were used. Positive urine samples were donated by patients presenting with new or recurrent transitional cell carcinoma of the bladder (Willis et al. 2004).

The significant media and public interest surrounding this research is in keeping with the attention routinely afforded to potential advances surrounding the diagnosis and treatment of cancer. Given its ubiquity and prominent place in public consciousness today, cancer is arguably the defining disease of modernity (Porter 1999 [1997] 574). Oncologist and author Siddhartha Mukherjee (2010, 241) has even identified cancer as 'the quintessential product of modernity'.

The public imagination regarding cancer research is largely framed by hope and hype and Margaret Lock (2008, 64) has illustrated that this is especially so surrounding potential breakthroughs in genetic medicine and the associated promises of predictive health care and 'personal medicine'. Indeed, despite the promises of biomedical science—the dominant imaginary of western medicine portrayed as the hero to win 'the war on cancer'—it has not yet fulfilled the advances that were expected decades ago (Faguet 2010). Correspondingly, Mary Good (2001) writes:

> Enthusiasm for medicine's possibilities arises not necessarily from material products with therapeutic efficacy but through the production of ideas, with potential although not yet proven therapeutic efficacy. (397)

Indeed, while there continues to be no cure for cancer, nor sufficiently reliable and safe diagnostic technologies for certain cancers, hope and interest in cancer research remains vast.

When the results of the charity's first study emerged, the notion of dogs detecting human disease was still in its infancy and presented a potential challenge to the status quo of clinical diagnosis that remains largely comprised of blood tests and imaging technologies. Recalling the moments when she first began to tell friends and colleagues about her interest in this field of research, Claire notes, "People thought I was mad. They thought I'd genuinely lost the plot." At times during the testing stage of the initial study, she admits she even began to doubt herself:

> "I really had no idea what the result would be. I sometimes wake up at night and think, my God—what if I've made it all up. It genuinely frightens me sometimes. It started with a little idea and now around the world people are talking about dogs smelling disease."

While this first proof of principle study and multiple subsequent studies thereafter have proved successful, there has been a substantial attitude of skepticism from some members of the scientific community directed towards the practice of training dogs to detect and alert to the odour of human disease. Some skepticism centers around the relatively low numbers of dogs and samples used in some of the studies, while other critics point to failed trials conducted by other teams of researchers (e.g., Hackner et al. 2016). Meanwhile, other commentators have raised concern about the changeable temperament of the dog, suggesting that something as unpredictable as 'a bad day' might negatively impact a dog's detection accuracy, reducing the reliability of this mode of detection.[22]

Furthermore, even if it is accepted that dogs can be trained to detect disease, questions have been raised about the utility of the potential application of bio-detection dogs. In 2015, in response to MDD's announcement of their plans to conduct a large-scale clinical study of the canine detection of prostate cancer, Dr. Kat Arney, Cancer Research UK's science information manager, made the following comment in a statement, questioning the practical value of this research:

> Any test for cancer must be shown to be reliable, specific and practical, and large-scale clinical trials are an essential part of this process. It will be interesting to see whether this new trial shows that dogs can identify prostate cancer better than current tests, but it's unlikely that canine cancer screening would be practical in the clinic on a wider scale. In the long term it would be useful to discover the identities of the molecules the dogs are sniffing, which could lead to more accurate lab tests to diagnose cancer.[23]

While the use of dogs detecting the odour of human disease might one day be an operational adjunct in the diagnostic process, my informants are indeed also committed to working towards determining 'the identities of the molecules the dogs are sniffing', as Arney puts it. Both organisations are interested in helping to develop more sophisticated

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[22] https://www.scientificamerican.com/article/if-dogs-can-smell-cancer-why-dont-they-screen -people/

[23] http://scienceblog.cancerresearchuk.org/2009/02/03/can-dogs-detect-the-smell-of-cancer/

diagnostic machines known as ‘electronic noses’ or ‘e-noses’: technologies that replicate the functions of human noses, but with greater sensitivity (Fox 2009). The potential scope of applications of such electronic systems is vast: for instance, they are already in use by perfume manufacturers seeking to defend their patented fragrances against counterfeits (Ibid.). In the area of medical diagnosis, early proof-of-principle studies have shown promising results for the accuracy of e-noses to detect ovarian cancer in breath samples (Kahn et al. 2015) and prostate cancer in urine (Roine et al. 2014). Thus, the future imaginary of disease diagnosis, as conceptualized by my informants who train these dogs, is not exclusively limited to a dependence on the physical presence of dogs. However, while the odour signatures that the dogs are alerting to continue to mystify scientists, the dogs will likely remain the starting point for such developments.

To offer an analysis of the skepticisim surrounding this practice, I suggest that it is associated, at least in part, with the present status of smell in western culture: a status that has shifted over time. Within contemporary western culture, out of all the senses, smell is considered with the least regard (Fox 2009). From the commencement of the Enlightenment, smell has been progressively devalued in the practice of truth-seeking practices in the west (Classen, Howes and Synnott 1994, 84) as sight became valued over all other senses, especially in science and medicine. Alain Corbin (1986, 154) describes this sensory shift as ‘the great swing in attitudes that was to give uncontested supremacy to the visual’. This valorization of the visual is highlighted in Michel Foucault’s (1973) notion of the ‘medical gaze’ that asserts that the physician develops his understanding of the patient’s illness through observation, physical examination, and laboratory tests or imaging. Thus, the patient’s body is constructed as an object of visual examination within medical science. This practice, of finding the hidden ‘truth’ of the body, is especially pertinent for cancer diagnosis, since cancer can manifest in the body for years without any clear external symptoms, growing undetected until very late stages of the disease.

While the visual has been at the center of empirical scientific thought post-Enlightenment, from this time onwards smell has long been not only neglected, but largely banished from the western consciousness. Anthropologists have suggested that this is a consequence of the ‘deodorization’ of modern life (Classen et al. 1994, 84), in which smell has been disparaged because ‘it is felt to threaten the abstract and impersonal regime of modernity by virtue of its radical interiority, its boundary-transgressing propensities and its emotional potency’ (Classen et al. 1994, 5). One of the consequences of this demotion

of smell, noted by anthropologist Kate Fox (2009, 5), relates to academic research, 'with the result that we know far less about our sense of smell than about more high-status senses such as vision and hearing'. Fox points out that the low status of smell is also reflected within the English language. For instance, while there exist many derogatory terms for 'nose' (e.g., snout, hooter), there are no terms of approval for smelling ability as there are with other senses (e.g., 'keen-eyed' or 'a good listener'). In fact, the only common expression which implies olfactory ability is 'nosy': a term of disapproval rather than honour.

Certainly, smelling is as much a cultural practice as a physiological act. Indeed, in many non-western contexts smell is highly valued and spoken about with greater ease. For instance, a recent study (Majid and Kruspe 2018) found that hunter-gatherers in the Malay Peninsula find it as easy to talk about odours as they do colours. Furthermore, for some communities, smell is a highly valued sense that plays a key role in defining the individual self and also in shaping everyday encounters between individuals. For example, among the Ongee people of the Andaman Islands, the universe and everything in it is defined by smell. As Constance Classen and colleagues (1994, 113) note, 'the identifying characteristic and life force of all living beings is thought to reside in their smell'. When greeting someone therefore, the Ongee do not ask 'How are you?', but 'Konyune? onorange-tanka?': 'How is your nose?' or literally, 'When/why/where is the nose to be?' (Ibid., 114).

Meanwhile, in the western consciousness today, smell is largely repressed and considered of low status. However, this has not always been the case. Indeed, since antiquity, smell has played a role in the diagnosis of human disease. According to the Greek physician Galen, a foul-smelling urine or excrement was an indication of putrefaction of bodily humors (e.g., Galen, De differentiis febrium 1.8 (7.302 Kuhn)). It is often noted that the role of smell in disease detection was also discussed by Hippocrates, who is said to have advised his students to 'smell your patient's breath' to search for signs of diseases including diabetes.[24]

Of the association between smell and diagnosis, David Howes (1989, 91) notes that 'In pre-Pasteurian times, most doctors and public health officials worked on the assumption that stench both signaled and communicated disease'. Thus, medical diagnoses involved a 'calculation of degrees of internal decay based on the odor of bodily waste'

[24] https://www.economist.com/node/12001831

(Corbin 1986, 20). Despite this valorized function of smell in diagnosis throughout ancient and modern history, today smell remains the least significant of the senses in modern western cultures (Fox 2009; McGann 2017).

Considering the temporally and culturally divergent status of smell builds an understanding of research practices involving the detection of human disease by dogs as a field of scientific study that, although appearing as novel, within a culture in which smell is widely undervalued, actually has roots in ideas that date back to antiquity. An acknowledgment of the contemporary relationship between knowledge and the senses in the west helps us to understand why a climate of skepticism might surround diagnostic practices that employ the sense of smell. Since the Enlightenment, sight has been integral to the method(s) par excellence involved in the diagnosis of cancer, in addition to other diseases. This is reflected in the routine visual technologies (e.g., Magnetic Resonance Imaging (MRI) and Computerized Tomography (CT)) used on the bodies of persons suspected of having cancer, in which a clinician's skill is applied in 'reading' these images. Meanwhile, the personal and emotional potency of smell has been understood to threaten modernity's impersonal truth-seeking practices (Classen et al. 1994, 5).

While the evolving status of smell might help us to understand the climate of skepticism that surrounds the practice of bio-detection dog research in particular, concepts from science and technology studies (STS), on the topic of knowledge production, illustrate the ubiquity of resistance as a reaction motivated by all novel kinds of knowledge that challenge the status quo.

In *Dreamscapes of Modernity* (2015), in which Sheila Jasanoff and Sang-Hyun Kim articulate and analyse their concept of 'sociotechnical imaginaries'[25], Jasanoff suggests that four phases characterize the processes through which visions of the future develop: origination, embedding, resistance, and extension. These four phases are well developed within the STS literature (e.g., Fujiumura 1992) and can be identified with regards to the future imaginary that involves the use of the dog's olfactory capabilities to develop accurate, non-invasive and rapid cancer detection methods. In this context, I have

[25] Sociotechnical imaginaries are 'collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of social life and social order attainable through, and supportive of, advances in science and technology' (Jasanoff and Kim 2015, 4-5).

illustrated how the particular future imaginary of dogs detecting human disease originated with the visions of a small number of actors, including Guest and Church. Gradually, with the successful results of rigorous clinical trials, these ideas are becoming embedded as realities, with this imaginary becoming steadily entrenched in how both individuals and larger organisations speculate about the future. Indeed, the majority of people recently surveyed in the UK support the use of trained dogs in the detection of human diseases[26] and the National Health Service gave ethical approval to MDD's proof-of-principle trial on prostate cancer and have also helped in the collection of samples on which the research relies. However, consistent with Jasanoff's (2015) insight, resistance has also been a characteristic element of the development of this future imaginary, here in the form of skepticism about the viability of dogs in the diagnostic process.

Now that the emergence of this area of research has been outlined, I turn to the training of bio-detection dogs to offer the reader a preliminary insight into the spaces and practices that comprise dog-training in this context.

ii. Obtaining Dogs

PVWDC obtain dogs through two main channels: breeder donations or in-house breeding. Regarding the first mode of dog supply—donations—the majority of the dogs are donated from professional dog breeders across the country. There are certain caveats for anyone wishing to donate a dog however. Most significantly, PVWDC only accepts purebred puppies from reputable breeders who are able to demonstrate the dog's lineage of proven performance and health. Required health qualifications for the sire and dam (the puppy's parents) include satisfactory results for tests related to the animal's hips, elbows and eyes. DNA tests are also required of sires and dams of certain breeds, to prove they are not afflicted by conditions prone to affect specific breeds. Proof of sire and dam working ability is established in titles or qualifications that can be gained in a variety of fields

[26] A recent YouGov (2018) poll of 2,047 British adults indicates that the public support the use of trained dogs in the detection of human diseases. More than four out of five respondents would be happy for doctors to use trained dogs to detect human disease in urine, breath and sweat samples. Report available at: https://d25d2506sfb94s.cloudfront.net/cumulus_uploads/document/89kmvgm0o5/YG-Archive-%2028092016-Medical%20Detection%20Dogs.pdf

including police work, search and rescue, or advanced tracking events organized by the American Kennel Club.

PVWDC never pays for a puppy; the dogs are donated to the organisation free of charge. If a breeder wants to donate a puppy but cannot afford to do so, a private donor might step in and pay the fee required by the breeder. The donations breeders make to PVWDC are publicly acknowledged by the organisation; for instance, when referring to a dog on their website or in social media posts, the breeder's name frequently accompanies the dog's name.

The second mode through which dogs are acquired by PVWDC is through the organisation's in-house breeding program—comparable, though on a smaller scale, to the breeding programs operated by many service or assistance dog organisations. Using dogs who have had successful working roles, PVWDC has bred eight litters of puppies since 2014.

In order to begin socialization and training from a young age, to control the dog's environment and record the dog's progress, PVWDC takes puppies from around eight weeks of age. The ability to monitor the dog's performance throughout the training process is considered essential to PVWDC's longer-term aim of developing tools for the assessment of behavioural traits which could reliably predict future success in training.

Once trained with the skills needed to work operationally, the majority of the dogs at PVWDC 'graduate' in their specialist field (e.g., narcotics detection), at which point they are sold on to handlers (e.g., law enforcement dog handlers) with whom the dog will relocate to live and work. A dog's age at graduation varies but typically falls between eight–12 months. Due to the current small-scale of the organisation's studies in cancer-detection, only a few dogs become specialists in this field. Whilst I was there, the center had three dogs assigned to this project. As this work takes place on-site at the center, these dogs continue to come in Monday–Friday, transported by their fosterers with whom they live.

Meanwhile, at MDD, where research ambitions do not include the development of a tool to assess puppies for future working success, dogs do not typically begin coming in to the training center until they are around eight months old. Thus, it is not considered essential to obtain dogs as puppies. Here, dogs are sometimes donated by, or purchased from, breeders who specialize in producing dogs from 'working lines' (i.e., a lineage of successful working dogs). Unlike PVWDC, MDD does not have an established breeding

program of its own. Other sources from which their dogs are procured include other assistance dog programs, such as the Guide Dog training program, with whom the charity has contacts and is informed of dogs that may be suitable. In these instances, the dog has typically been rejected from the previous organisation because he displayed a preference for scent-focused engagement with the world, over the visually-oriented behaviours that are essential for the Guide Dog role.

Additionally, the trainers occasionally receive tip-offs through friends in the working dog industry, including police dog handlers, who alert them to potentially suitable dogs. Occasionally, dogs are also donated by rescue centres and members of the public. Prior to taking on a dog, an initial assessment is carried out, usually at the center, in which a trainer observes the dog's persistence and performance in a series of search games. For instance, the trainer will throw a tennis ball into a field of long grass and assess how long it takes the dog to find the item and how eager he is to engage with the 'game'. While the dogs at MDD tend to be acquired at an older age than the puppies at PVWDC, if they are procured as puppies, the dog will stay at home with a foster family until he is deemed mature enough to begin coming in to the center and start training.

iii. Training Noses

Both organisations train female and male dogs alike and there are no significant differences between the numbers of each enrolled in the training programmes. Whilst I was in the field, MDD had an average of thirty dogs in their bio-detection training programme, spanning several different research projects. Meanwhile, at PVWDC, there was an average of twenty-five dogs in training. Of this cohort, only three were specializing in bio-detection. The others were in training for more traditional detection specialties of explosives, drugs, and search and rescue of missing people.

The training of bio-detection dogs takes place in specific areas designed with particular materials and equipped with certain equipment. My informants refer to such space as the 'training room', or sometimes the 'bio-room'. At MDD, the training room is located at the center of the bio-detection department: sandwiched between the department's office on one side, and the viewing gallery and sample preparation area on the other. The wall dividing the training room from the viewing area is made of transparent glass sheets, facilitating spectatorship. Trainers and dogs enter the room through a door from the bio-

detection office: an entrance that is reinforced with a child safety gate between the office and door, used to prevent dogs from sneaking into the room when it is not their turn. The room itself is quite clinical in design with white walls and a vinyl flooring that is both non-slip and easy to clean. Certain features of the room are explicitly geared towards the welfare of the dogs. For instance, on the floor by the door is a water bowl that is re-stocked with fresh water throughout the day. A temperature monitor sits on the workbench, with the temperature recorded at the outset of each training session. One of the trainers informed me that the optimum temperature for the dogs to work in is around nineteen degrees Celsius. Trainers routinely monitor the temperature at the outset of each training session and adjust the room's air-conditioning system accordingly.

The space is largely uncluttered, containing only what is deemed essential for training: a stainless-steel carousel with eight arms protruding from a central stand and four stainless-steel stands. The dogs at MDD are typically trained to navigate one of these two 'systems'. When not in use, this equipment is dismantled and pushed to one side of the room. The only other pieces of furniture in the room are a small desk, chair and a workbench that runs along one of the walls. The workbench comprises cupboards containing various additional items of training kit including: stainless-steel arms and pots to attach to the carousel or stands, multiple packets of kibble treats, tennis balls and plush toys, a portable steam cleaner, a bin for hazardous waste (e.g., urine samples), and stacks of boxes containing nitrile gloves. On top of the workbench sits a television screen linked up to the two closed-circuit television cameras positioned in opposite corners of the room to record training and testing sessions. A radio on the window sill, tuned into a popular British music station playing chart hits, provides background noise to the training sessions. The samples used for training—comprised of urine in vials, sweat-infused socks and gauze swabs—are stored in freezers outside the training room. Prior to training, the trainers must retrieve and prepare the required samples. With some of the freezers located in a corridor that extends from the office in which the dogs dwell when they are not working, the trainers are often watched by several interested canines as they collate samples:

Stood next to the freezers, Ed helps Alexa to retrieve specific urine samples to use in this morning's prostate cancer training sessions. Alexa reads out a list of sample numbers from a sheet, whilst Ed, wearing nitrile gloves, looks for and retrieves the samples from the freezer. For each number Alexa calls out, Ed finds the matching freezer bag, labelled with permanent marker, and takes one vial out from the bag. He places the vial in a

corresponding plastic pot, with the sample number already labelled in biro pen by Alexa. The pots sit on a tray on the windowsill until all samples are present. To reduce the risk of contamination, Ed takes out all eight of the control samples first, before opening a different freezer from which he retrieves the two target samples. On a separate tray, he places each target sample vial in a pot, again numbered but also marked with a large 'X' that distinguishes them as targets.

Once all the samples are present on the trays, Alexa picks up both trays and makes her way towards the training room. Whilst walking through the office, Alexa spots Maddie sitting in her chair and the pair catch each other's gaze. Alexa calls out "Maddie, off!" and after a moment's reluctance, Maddie jumps down onto the ground. Then, resembling the Pied Piper, Alexa is followed into the training room by Maddie and several other dogs at her feet. Many of these dogs had been peacefully dozing throughout the office for the past thirty minutes but now, stirred by the noise and movement, appear keen to see what is happening. The dogs' paws tap on the vinyl floor as they shadow Alexa, who carefully navigates her way around the carousel in the center of the room and places the trays down on the counter-top where the vials of urine are left to defrost over the next twenty minutes.

PVWDC also has a space dedicated to the training of bio-detection dogs, contained within the organisation's research office. In addition to training dogs working on the center's study into cancer-detection, this room is also used as a space to teach young dogs the odour-detection 'game', using a training odour. This room is tucked away towards the back of the building, away from the kennel area. The room is accessed either through a door from an adjacent training room, used for conducting the dog's exercise and strength-training, or when the fitness room is in use the training room is accessed through an external door that opens onto the parking area.

Consistent with the design and materials of MDD's training room, vinyl floors and stainless-steel equipment are employed here for ease of cleaning. The training space is materially separated from the office by a temporary wall divider, with the training area featuring a carousel. In one corner of the training area, is a tripod holding a video camera. Beyond the training area is a door to a room that serves as a viewing area fitted with a one-way tinted window that overlooks the carousel. Although members of the public do not

spectate from here[27], given its limited space, this window enables several volunteers and interns to observe training sessions and record data, without overcrowding the training area. In the office, shelving units store the stainless-steel containers used to hold odour samples as well as boxes of nitrile gloves and cleaning equipment. One of the walls is decorated with photos of the center's cancer-detection dogs, their names and sponsorship acknowledgments (Figure 1). Hand-drawn signs with the names of particular dogs are also stuck to the wall and when necessary, these are placed on the other side of the door to the research office, in the fitness room, to communicate to people that a specific dog is currently in the room (Figure 2). The signs help staff to prevent disruptions or particular interactions between certain dogs and people.

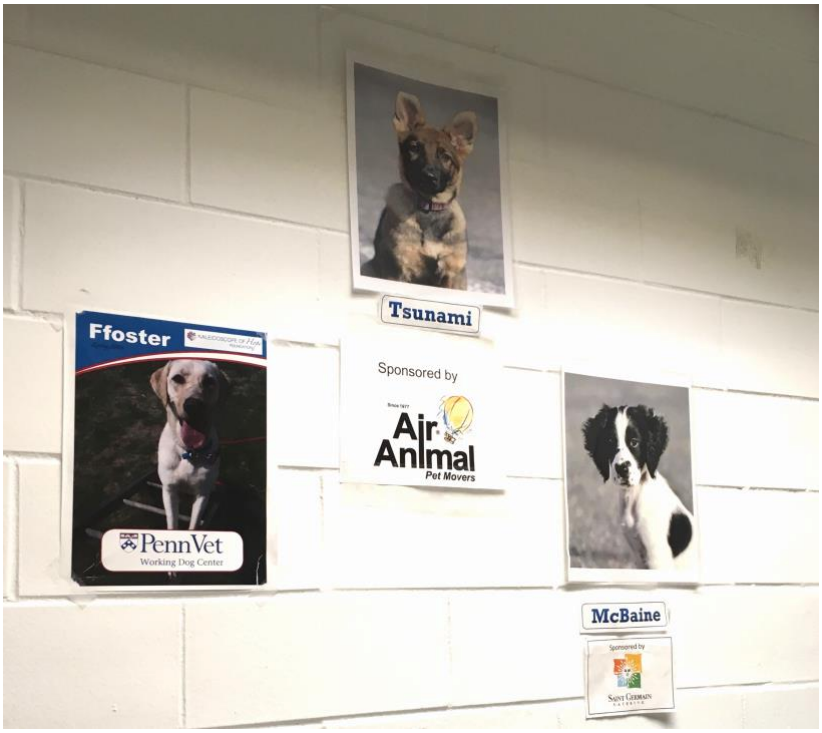

Figure 1. Photos of the PVWDC cancer-detection dogs, their names and sponsorship details are stuck to a wall in the research office/training room.

[27] While members of the public do not watch training from this area, PVWDC hosts bi-monthly tours and demonstrations to members of the public and school groups. Typically, these tours take place in the center's main training room and the outside rubble yard, where dogs are demonstrated taking part in various scent-detection and agility activities.

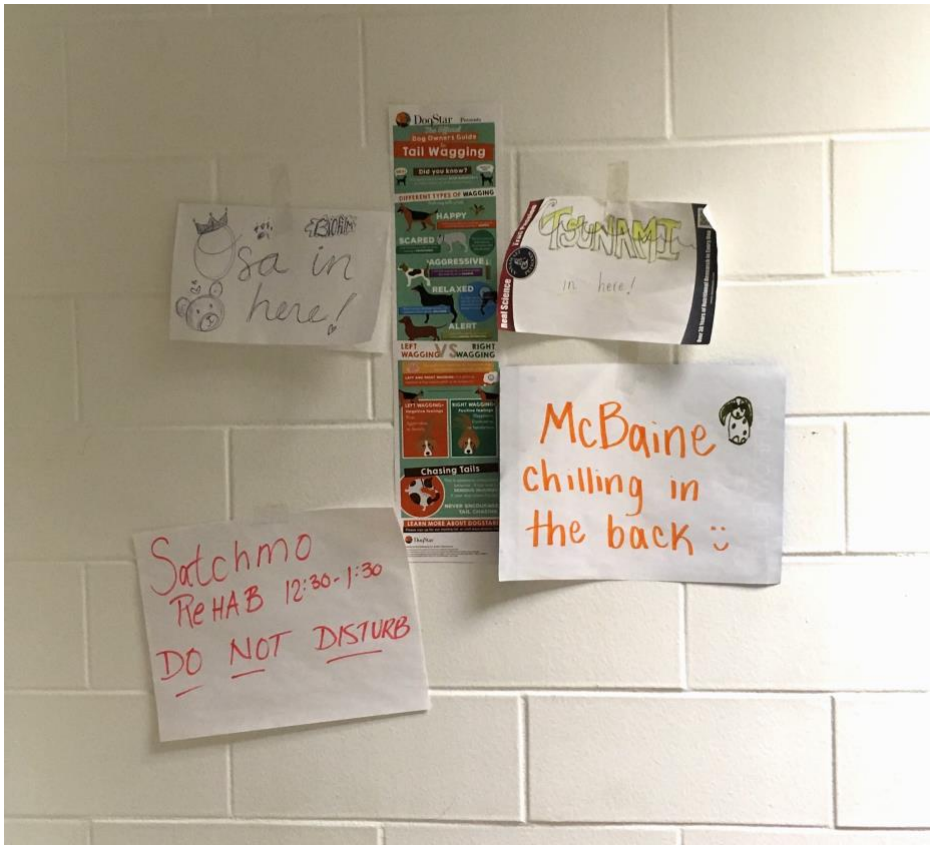

Figure 2. Hand-made signs to communicate the presence of particular dogs within the research office/training room stuck to a wall.

Dogs being taught to detect the odour of human disease train between three and five days per week in the spaces described above. A training session lasts between twenty and thirty minutes and dogs take part in up to three sessions per day. It is through training that dogs learn the 'game' of scent-detection. This game has two main parts: firstly, the dog must learn to recognize the particular odour he is being trained to detect; secondly, he must learn to signal the presence of this salient odour to his trainer. To teach the dogs to recognize certain odours, trainers employ 'clicker training', using the sound of a clicker to communicate to the dog that they are demonstrating a desired behaviour. After a click, comes a reward (usually food). During the early stages of a dog's training, a click might be offered for briefly looking at the odour source. Progressively, the trainers hold out for a longer stare at the source, and eventually they might ask a dog to 'sit' at source, if the dog has not himself already offered this behaviour. Gradually, through this process, the dog learns the behaviour he must exhibit in order to communicate to his trainer the presence of the target odour: the 'operant response', as it is referred to by dog-trainers.

Additionally, as training progresses, dogs must also learn to ignore control odours that might contain some volatile organic compounds (VOCs) that overlap with those present in the 'background' of the target odour, increasing the difficulty of the dog's task. For instance, a 'dirtier' control sample—as my informants describe them—is typically one obtained from an individual who both matches the age of the target sample patient (e.g., usually an older individual when training for prostate cancer detection) and also shares some of the symptoms experienced by the target sample individual. Whilst certain aspects of the samples are thus matched, the control sample remains negative for the particular disease under study, according to hospital laboratory tests; the details of which accompany the samples provided to the trainers.

Whilst dogs are inherently inquisitive of the odours that comprise their environment, the process of becoming a bio-detection dog—capable of reliably alerting to the presence of a particular combination of VOCs at very low sample concentration thresholds[28]—takes several months of dedicated training focused on their bodies and, in particular, their noses. Training dogs to indicate to the odour of human disease means training them to respond in specific ways to gradually subtler differences in odour. This practice can be considered a kind of 'bodywork' (Wolkowitz 2006; Twigg et al. 2011) performed in the human–dog-training encounter, whereby bodywork is understood as 'work that focuses directly on the bodies of others: assessing, diagnosing, handling, treating, manipulating and monitoring bodies, that thus become the object of the worker's labour' (Twigg et al. 2011, 171). To provide an illustration of the bio-detection dog-training process, I turn to my field notes:

I have only been in the field at MDD for two weeks and I am excited to be inside the training room to observe new recruit Meg's first training session. Whilst I have already observed several training sessions with dogs that are more advanced in their training, this is the first time I will be watching a dog from the very beginning stages. Neil walks over to the door that opens to the office, opens it and calls out 'Meg'. I watch through the window—between the training room and office—as Meg, a yellow Labrador pushes past

[28] The concentration of the specific odours these dogs are being trained to detect is as low as parts per trillion. To put this into context, Horowitz (2010, 72) explains: 'We might notice if our coffee's been sweetened with a teaspoon of sugar; a dog can detect a teaspoon of sugar in a million gallons of water: two Olympic-sized pools full'.

the motley crew of dogs huddled at the door, eventually making her way into the training room through the door held ajar by Neil. With her nose low to the ground, Meg explores the room. Noticing her sniffing this new environment, Neil exclaims, "Good girly!" From the workbench, Neil picks up a plastic pot—the kind you might use to give a urine sample to your doctor—labelled with a black 'X', identifying it as containing a target odour, and unscrews the lid, placing it on the side. Inside the pot is a wad of white filter papers. He tells me the filter papers have been 'soaked' overnight with a 'training odour': an odour that is now 'imprinted' on the filter papers. "What does it smell like?", I ask him. He holds out the pot towards me, offering me the chance to investigate the odour. I hover my nose about an inch from the pot and take a sharp inhale through my nostrils. I comment that it smells similar to marzipan. He tells me that the smell is 'man-made' and thus impossible for the dog to encounter anywhere else in the natural environment. This, he explains, is why dogs are first trained to search for odour using this artificial training odour. Since this will be Meg's first introduction to this odour, Neil is using a large quantity of soaked filter papers in order to produce a strong odour. As Neil explains, by using this large volume of odour, he is "reducing the criteria because she is new."

While Neil and I have been chatting about the odour, Meg has been checking out the room. "Meg, do you want to do some work?", Neil asks. Neil squats down on the floor and holds the pot out in front of him. With his other hand, he holds a clicker that is attached to a band around his wrist. His thumb and forefinger grip the clicker, poised ready to activate it. As he bends down to the ground—his head now at Meg's eye level—Meg comes over to him. Suddenly, he has become interesting to her. She sniffs around his body and then sits and looks at him in the eyes. Neil shakes the pot gently in his hand to draw Meg's attention to it. After a momentary stand-off, Meg moves towards the pot and hovers her nose over it for a moment. Neil clicks the clicker in his other hand, causing it to produce a quick sharp sound, 'capturing' this desired behaviour. Meg looks up into Neil's eyes then follows his hand as he reaches for a piece of kibble from his pouch attached to his belt and feeds it to Meg. After she has finished chewing this—in less than two seconds—Neil throws another piece of kibble a few feet away towards the back of the room to give Meg the chance to leave the odour and to come back to begin the same process again. It appears to take around five clicks of this behaviour before Meg seems to realize that the reward is a consequence of her nose being over the pot. Neil explains that he can gage this based on how quickly Meg is now going back to the pot. Whether she has connected the reward to the odour itself, or merely to her nose being over the pot, can only be put to

the test when a control odour is presented in the same lineup, thus giving Meg a choice. Because this environment and kind of work is new to Meg, Neil explains that today he does not want to "push her too quickly" through the training stages. He ends the session with her by playing with a plush tug toy he pulls out from a cupboard underneath the workbench.

The next day however, I get to see Neil add the next step in to Meg's training. After repeating the above exercise around five times, Neil moves the plastic pot onto the floor. He covers it with a stainless-steel container, double the size of a standard coffee mug and with a penny-sized hole in the middle of the top. Intrigued by the novel object on the floor, Meg walks over to it and sniffs around. When she moves her nose directly over the hole, Neil clicks and rewards Meg. He rewards her for repeating this behaviour around five more times before placing another steel pot on the floor, approximately two feet apart from the original. He leaves this pot 'blank'. Meg walks over to the novel pot and sniffs it, her nose eventually protruding through the hole on the top. She moves her head away from the pot and looks up to Neil, whose face remains straight. "Now you've got to think about it," he says. Indeed, if she is to succeed as a bio-detection dog, Meg must quickly learn that her reward does not come when she is merely sniffing any pot, but when she is sniffing the pot containing the 'target' odour. In short, by adding in a blank pot, Neil is attempting to accentuate, for Meg, the association between target odour and reward. Watching how Meg works with the blank pot added to the lineup, Neil can gage the extent to which Meg is beginning to understand the logic of the game.

I note that parallels can be drawn between the practices illustrated in the above examples taken from my field notes and Latour's (2004) analysis of a student learning to distinguish between subtly contrasting perfume scents. Latour emphasizes the notion of 'affect' to consider the body of the perfume student as an entity that, guided by a teacher, is undergoing 'training to be affected':

> Through his kit and his ability as a teacher, he has been able to render his indifferent pupils attentive to ever more subtle differences in the inner structure of the pure chemicals he has managed to assemble. He has not simply moved the trainees from inattention to attention, from semi-conscious to conscious appraisal. He has taught them to be affected, that is effected by the influence of the chemicals which, before the session, bombarded their nostrils to no avail…Before the session,

> odours rained on the pupils without making them act, without making them speak, without rendering them attentive, without arousing them in precise ways: any group of odours would have produced the same general undifferentiated effect or affect on the pupil. After the session, it is not in vain that odours are different, and every atomic interpolation generates differences in the pupil who is slowly becoming a 'nose', that is someone for whom odours in the world are not producing contrasts without in some ways affecting her. The teacher, the kit and the session are what allow differences in the odours to make the trainees do something different every time instead of eliciting always the same crude behaviour. The kit (with all its associated elements) is part and parcel of what it is to have a body, that is to benefit from a richer odoriferous world. (Ibid., 207)

Latour's analysis can be employed to understand the experience that the dogs undergo as they progress towards becoming bio-detection dogs. Like the teacher Latour describes, the trainers in the case of bio-detection dog-training, also depend on a range of material items that can be considered 'kit'. During the initial stages of the training process a trainer's kit is typically comprised of the training odour, filter papers, plastic pots, stainless-steel pots, food rewards and their skill and experience as dog-trainers. As training progresses, this kit evolves and new odours and equipment are incorporated. For instance, the training odour is replaced with the odour of the human disease the dog is being trained to detect, presented in the form of a biological substance such as urine or sweat-imbued gauze swabs. Instead of pots on the floor, stands or a carousel are used to present samples.

Drawing on Mol's (2000) analysis of atherosclerosis, as an object of scientific inquiry that requires ongoing re-enactment through engagement with certain scripts and equipment, I propose that these items of the trainer's kit enable the repetitive re-enactment, or performance, of the reality of bio-detection dogs. Thus, following Birke and colleagues' (2004) exploration of the notion of the lab rat as a *doing* or *becoming*, bio-detection dogs ought to be understood not as a pre-existing category, but as emerging out of the encounters between the dog, people and the various associated technologies including the trainer's kit.

With these kits, the trainers teach the dogs to become affected in particular ways in their interactions with the odours, which prior to their training would not have caused them to act in such precise ways. As a reward for showing interest in the smell at this early stage in the training process, Meg is given food treats—something she is perceived as

desiring. Thus, by providing the dog with something she is understood to enjoy, the dog comes to understand how 'she, through her own actions, can have an effect on what happens to her' (Koski and Bäcklund 2017, 21).

Here, training can be evaluated as successful if the target odour renders the dog attentive. Thus, in the same way as students learning the aromas of perfumes are described by Latour, the dogs can be understood as gradually learning to 'have a nose', or learning to 'be a nose'. Fundamentally, the dogs are becoming beings for whom particular odours are affecting.

However, whilst Latour focuses on subtle contrasts of aromas that become available to humans through training, the odours that bio-detection dogs like Meg will eventually learn to be affected by in their training process—the VOCs emanating from prostate cancer—are comprised of such low concentration thresholds that they are elusive to the human olfactory system.[29] Of course, this is why the dogs are required for this work, given their more sophisticated olfactory capabilities. Thus, one can observe a significant distinction between Latour's case of the perfume students, in which humans are trained by other skilled conspecifics, more or less equally endowed in their olfactory capability, versus the case of bio-detection dogs, whereby dogs, as a species unequally endowed with regards to their olfactory capabilities, are trained by humans who fundamentally lack the ability to themselves be affected by such odours.[30]

Furthermore, the composition of these odours are largely mysterious to scientists in ways that the odours of more conventional dog-training are not (e.g., drugs and explosives). To help articulate to me what this means to them and what its implications are for training, the trainers would often compare the odour of human disease with the odour of explosives

[29] See note 28.

[30] Whilst most humans are unable to match the olfactory capability of the dog, there are some examples of rare human 'super sniffers'. For example, a clinical test proved that Joy Milne, a retired nurse from Scotland, is able to identify people with Parkinson's disease from those who do not have the condition by smelling clothing worn by the individuals. Milne is now working alongside the medical professionals and scientists who are working with Medical Detection Dogs to assess whether dogs can be trained to identify Parkinson's using skin swabs. See: https://www.telegraph.co.uk/science/2017/07/09/dogs-could-sniff-parkinsons-disease-years-symptoms-appear/

or drugs. For instance, when training dogs to detect explosives, it is possible to train using a so-called 'pure' odour; in short, an odour that one can be certain of with regards to its composition, such as the particular chemicals emanating from explosives. The odour can be made gradually more challenging for a dog to find over time, for instance by reducing the quantity of the target odour presented to a dog and thereby decreasing its strength. Thus, it is possible to keep track of the odour's consistency. The same is not true when training the detection of human disease however, where the precise odour associated with a disease is likely subject to variation between individuals. The 'challenge' with cancer—and indeed disease detection training more broadly—reflects a gap of knowledge regarding these odours. As put by Claire, during filming for a television interview at the charity's headquarters:

> "…we [i.e., the people guiding the training and research] don't know if the odour is there or not, so we have to give the dog the 'soup', if you like, and we believe the ingredients that will be in that soup are associated with cancer. The only way we can do it is to put samples in front of the dog from people we know who have cancer against people who are healthy."

My trainer informants frequently employed analogies such as 'the soup' to talk about the uncertainties of odour in disease detection. For instance, Neil at MDD explained to me: "They [trainers of explosives-detection] can tell the dog what it's looking for, but we're telling the dog to find a needle in a haystack without having a needle to show them what they're looking for." The uncertainty of the odour featured frequently in conversation among the trainers. During a discussion in MDD's bio-detection office one day, one of the senior trainers, Simon, reflected on some of the mysteries associated with this particular field of training and research:

> "We don't actually know what the dogs are responding to. Is it something that cancer produces? If it is something that cancer produces is it from the organ, is it from the cell, is it from the damage it does, or is it from the body's response? They're the things that we're trying to work out."

Thus, in the specific context of bio-detection training, these dog-trainers-come-researchers must navigate an ambiguity with regards to the odour.

Whilst the specific practices of training introduced in this section are fundamental to this thesis and discussed throughout in greater detail, before delving into further analysis of the training, I propose that it is important to preface the forthcoming chapters with a recognition of the multiple social worlds within which these dogs are embedded. This will help to offer a richer understanding of this work and the dogs. In addition to the above-mentioned groups of people—trainers, patients and the scientific community—bio-detection dogs are entangled with the lives of another social group: volunteers. It is the relationships between bio-detection dogs and volunteers, specifically fosterers and interns, that are explored in the following section.

iv. Beyond the Nose: Kinship and Companionship with Bio-Detection Dogs

> "What they [the dogs] bring is so much more than the nose." (Cynthia Otto, Executive Director of PVWDC)

Although it is possible to situate the practice of using dogs to detect human disease within a broader social and medical landscape, in which the potential of animals to support human health in innovative ways is being increasingly recognized and utilized[31], it is important to understand that the work of bio-detection dogs is distinct in several significant ways from the labour performed by dogs enrolled to support human health in various other ways. This is the case even when human odour remains central to the dog's work. Notably, in contrast to 'medical alert' assistance dogs, who are trained to help individuals to manage their medical conditions, such as diabetes, bio-detection dogs are *not* trained to detect odour emanating directly from human bodies. Instead, I have illustrated that bio-detection dogs search for the odour of disease via biological samples, such as urine, that are presented in sterile containers. The 'positive' samples used to train and test bio-detection dogs are donated by patients with a confirmed diagnosis of the particular disease in question, while control samples are donated by 'healthy' individuals.[32]

[31] For instance, the rise of pets as therapeutic adjuncts (e.g., Wells 2009), or the reintroduction of maggots into hospitals to clean patient's wounds.

[32] In addition to human biological substances, I also observed bio-detection dogs being trained to detect the odour markers of laboratory-grown bacteria cultures.

Furthermore, medical alert assistance dogs are paired with one individual for the course of a dog's lifetime and trained to alert that person to changes in their bodily odour that could indicate an imminent danger to the person's health[33], whereas bio-detection dogs work under controlled conditions, investigate samples from hundreds or thousands of individuals and never come into direct contact with those people. Moreover, in contrast to assistance dogs more broadly (e.g., guide dogs for blind people and hearing dogs for deaf people), who are partnered to support individuals twenty-four hours a day, bio-detection dogs follow a balance of work and home life that resembles more closely the daily structure of the humans with whom they work alongside. At both organisations where the fieldwork informing this thesis was conducted the dogs come to 'work' or 'school'—both terms were used interchangeably by informants at both field sites—during the daytime between Monday and Friday.[34] Each bio-detection dog lives within the home of a 'foster parent/family', whose role involves transporting the dog to and from the organisations' respective facilities each day.

Fosterers

A car pulls up outside the office and the driver, a woman who I guess to be in her fifties, lifts the boot door. She grasps the end of a lead with one hand, as Dougie, a black Labrador, attached by his collar to the other end of the lead jumps out. Dougie rushes over to the door of the office, the lady doing her best to keep up with him. Striding through the door, he wags his tail and greets the other dogs with sniffs of their bodies. Tails wag and paws dance as Dougie and Maddie greet one another. I am the only person in the office whilst the trainers are busy walking dogs. Dougie's human companion, Sue, asks if it would be possible for Dougie to miss a day of work soon, as she has a family trip planned to the beach and she would love to take him with her, since last time he joined them at the beach she tells me Dougie had "such fun." I promise to ask Alexa, Dougie's trainer, and get back to her. Sue, I instantly realize, is Dougie's fosterer, caring for Dougie in her family home in the evenings and weekends when Dougie is not here at 'work'.

[33] Academic research that has explored the work of medical assistance dogs from a social science perspective include Fenella Eason's (2017) unpublished doctoral thesis and Avigdor Edminster's work (2011a; 2011b).

[34] Typically, the dogs are on site between 8.30am–5.00pm at MDD and 8.00am–6.00pm at PVWDC.

Shortly after Sue leaves, I see Alexa and mention Sue's request. Alexa says it will be fine for Dougie to take a day off, as the testing phase for his assigned project (Parkinson's disease detection) is many months away and at the moment he is receiving 'maintenance training' to keep his nose and brain engaged. She tells me that as Dougie is currently on-site three days a week for training and progressing well, missing just one day will not hamper his progress. In fact, she suggests that a short break away "might even do him some good."

Dropping the dogs off in the morning and collecting them in the evening is an activity that both organisations liken to the 'school run'. Such an analogy clearly implies notions of the dog as a substitute child: a theme returned to at the end of this section. At PVWDC, dogs have individually assigned indoor kennels in which they are housed during the day when not participating in training, exercise, grooming or toileting activities. When fosterers drop 'their' dog off each day, they first weigh the dog on a set of scales just inside the door to the kennel area, noting the dog's weight on a chart fixed to the wall above the scales. Then they open the door to their dog's particular kennel, removing his or her leash and placing it in a basket attached to the kennel's exterior. Whenever a dog is escorted to or from his kennel, barking can usually be heard from at least one other dog. Sometimes, after leaving their dog in his kennel, fosterers will stop and greet other dogs through the kennel bars, but often they simply drop their dog off and leave.

At MDD however, the dogs are not housed in kennels but kept together in the bio-detection office during the day, largely free to roam between the various beds scattered around the room. Such a set-up promotes social interactions between the dogs and the establishment of canine social relations. Dog play is monitored by the trainers who step in when dogs are getting too 'hyped up' or noisy in their play. Child safety gates are employed to divide the office space and manage the flow of dogs, with particular dogs grouped together according to which dogs are known to get on best with each other. This particular arrangement also presents fosterers with opportunities for interacting with other dogs besides the one they foster. Some fosterers develop particular greeting rituals with the dogs who they gradually come to know by name. For instance, one morning at around 9am, towards the end of the daily drop-off period, Liz arrived with Sammy, a black Labrador, at the end of a leash. A woman in her seventies, Liz opened the door to the office and unclipped Sammy's leash from his collar, hanging it up on the hooks by the door. All of the dogs present in the main part of the office got up from where they had been lying

down and made their way towards Liz. Most sat down in front of Liz, though she had to prompt a few of them to do so, before putting her hand into her pocket and pulling out some kibble treats. One by one, she uttered the name of each dog as she fed a treat to each of them. As she handed out the treats, Liz remarked, "I can feel Sammy's eyeballs popping out his head when I give other dogs treats." Once all the dogs had received a treat, Maddie, a small cocker spaniel, raised her front paws up on to Liz's thighs. Liz rubbed her hands over Maddie's ears and sides, as she said, "Oh Maddie, just a quick cuddle then." I observed this same routine between Liz and the dogs happen many more times during my time at MDD.

Fosterers undergo training sessions with the organisations to ensure their ability to care for one of the dogs and maintain consistency in the dog's training at home. For instance, fosterers are obliged to adhere to their respective organisation's particular set of commands used to communicate with the dogs. Officially 'owned' by the organisations, the costs associated with these dogs' care (i.e., food, veterinary expenses, beds, crates, toys) are covered by these institutions. For many fosterers of bio-detection dogs (and also fosterers of detection dogs of drugs and explosives at PVWDC), the potentially life-saving nature of their dog's 'job' gives them a great sense of pride. For instance, on the first day of double-blind testing[35] for a proof-of-principle study focused on the detection of a particular bacterium, working through all the samples took longer than anticipated and one of the dogs involved in the project, Ziggy, still had several runs to complete before his testing was finished for the day. Lisa, Ziggy's 'mum', arrived to collect him at 5pm and was told by his trainer that he would be needed for another thirty minutes. The trainer offered to arrange for Ziggy to be dropped home later by a member of staff, but Lisa replied that she was happy to wait for him, adding, "This is really important work. I don't mind at all."

Instilled with a sense of importance about the kind of work these dogs do, fosterers often expressed a heightened feeling of responsibility for these dogs' health and safety, in comparison with that towards their own pet dogs: a pressure that arguably stems from the recognition of the societal value of these dogs and an understanding that these dogs do not fully 'belong' to them. "I know to the core that this is not my dog," were the words of Julie, a senior member of PVWDC's administration, and fosterer to Zach, a dog in training

[35] In double-blind conditions, nobody present (i.e., neither the dog-trainers nor any collaborating researchers) knows which samples are which.

to specialize in drugs detection. Julie and I chatted in the office she shares with the center's Training Director and Training Manager, overlooking the center's main training room through windows in the wall that divides the two rooms. Prompted by my questions, she mulled over the differences between how she perceives of and treats her family's pet dog, Katy, versus the way in which she thinks about Zach. Some of the differences are explicit in Julie's everyday routine that she talked me through. For instance, she told me that Zach always "rides in a crate" in the car, while Katy does not. In addition, Julie also explained the state of hypervigilance she often feels herself in when at home with Zach, telling me a story about Zach getting hold of and consuming a piece of garbage as her husband put the trash bag out:

> "As he [Julie's husband] walked by a bush, it ripped open the trash bag, this thing came out that had all of this congealed, greasy stuff from something that we had cooked and that I had drained out and let solidify. Zach went right in and he ate it. So, it's like, if that were Katy, I'd be like 'ugh that's gross', but I'm like 'I have to report this'. So I call Cindy and I'm like, 'Cindy, hypothetically speaking, if Zach did this do I make him throw up or do I just deal with the incredible diarrhoea I'm sure he's gonna have?' And so he ate some toast and he actually didn't have bad diarrhoea. But I wouldn't do that for Katy. I feel like I report everything. It could be the tiniest thing but everything matters with these dogs."

This sense of care felt towards these dogs, as beings whose skills and labour are prized, is also implicit in more mundane practices. For instance, often during drop-off and pick-up, fosterers ask the staff how their dog has done in training during the day and enquire as to whether there is anything additional they could be doing at home with the dog in order to help them improve in certain areas. Most often, the dog and fosterer would be sent home without additional instruction for 'homework', marking a distinction between their work and home life.

At the same time, however, the trainers maintain an interest in the dogs' home lives and use this information to build a more complete understanding of a dog's personal biography. For example, one day in the sample preparation area at MDD, Simon was chatting to Carla, a volunteer who comes in for a few hours once every week or two to 'break down' the urine samples for the prostate cancer training. Using pipettes, Carla meticulously divides each sample donated to the charity into 1 milliliter quantities, stored

in glass vials. Carla is also a fosterer for the charity and her foster dog, eight-month old Labrador Charlie, who she has looked after since he was a ten-week old puppy, recently passed an initial assessment with the bio-detection team. He has since been coming in for training sessions several days per week. Having worked with Charlie earlier in the day, and been impressed by Charlie's growing confidence, Simon asks Carla whether she has been doing any new activities at home with Charlie: "Have you been doing anything different since he came in for initial assessment?" Carla says she's been playing a few more search games with Charlie in the garden, hiding a ball for him to find. She also says that when she watched Charlie during his assessment—which took place while she was doing her voluntary work, meaning she could catch glimpses of the session—she noticed that he seemed a bit fearful of the cardboard boxes. Cardboard boxes are often used by trainers as part of their assessment of potential bio-detection dogs, with kibble hidden underneath the boxes to help assess the dog's willingness to search. Carla explained that she saw how Charlie appeared unsure of what to do with them, so she has started hiding food for him in boxes at home. Simon tells her that Charlie has worked really well today and Ed agrees, saying that he looks like a different dog from his initial assessment. The conversation ends with Simon telling Carla to keep doing what she has been doing.

When dogs become older, usually around eight years old, or if they suffer ill-health, they are 'retired' from their roles and live out the rest of their lives as pets, often within the same family that has fostered them throughout their 'career'. During my stint in the field, Sammy was retired due to a medical problem related to a disc in his back. While his medical care for this issue continued to be overseen by the charity, Liz was only too pleased to care for him full time within her home. One of the trainers told me how great he thought it was that Sammy was going to live with Liz permanently, explaining that a few years earlier, Liz's husband had passed away. In discussion with other trainers, they all agreed that having Sammy enter Liz's life when her world had been essentially thrown into chaos had given Liz a great sense of focus and joy.

Given the deep bonds, care and responsibility that characterise the relationships with the dogs as experienced by fosterers, the trainers regularly frame these relations in kinship terms, often referring to the fosterers as a dog's 'mum' or 'dad'. The analogy drawn between pets and children has a long history, beginning in Britain at the end of the seventeenth century (Thomas 1984, 117–19) and in the United States in the eighteenth and

nineteenth centuries (Grier 2006, 198–9). However, whilst acts of care incorporate bio-detection dogs into families as dependents, my observations lead me to conclude, following Charles (2016) that dogs are not necessarily regarded as surrogate children by their human caretakers. Rather, as Charles (Ibid.) proposes for many families, it is arguably the case that the dogs are valued precisely because they are dogs.

Interns

Fosterers comprise a significant proportion of the voluntary workforce at both organisations. However, at PVWDC, volunteers are also fundamental to the everyday running of the center's training programme, including practices of training, research and care. Working regular shifts each week, the center had an average of thirty volunteers and interns during my time in the field. In addition to supporting trainers by handling dogs and collecting data, a large portion of the volunteer's time is spent potty-walking, grooming dogs, and guiding dogs through 'Fit to Work' exercises.[36] Interns work alongside a trainer, whose cohort of dogs (usually a group of around six per trainer) they develop an intimate knowledge of and close bonds with as a result of the frequent and mundane encounters afforded by activities such as grooming.[37] Most interns confessed to having 'favourites' among the dogs and I would often catch sight of the same interns sat inside the kennels of particular dogs, with the dog sat on their lap or in front of them, as they stroked and talked to the dog. After their internships come to an end, some would occasionally return to visit particular dogs who they grew close to. For this unpaid work force, the dogs become companions: another aspect of the multiple identities these dogs embody.

[36] The 'Fit to Work' programme, devised by PVWDC and a mandatory component of all their dogs' training, consists of strengthening and conditioning exercises aimed at protecting against injury. The fit to work routine is considered especially pertinent for those dogs who will graduate and become operational in fields of detection such as search and rescue, where the risk of injury is especially a concern. As one of the PVWDC trainers explained to members of the public during another visitor demonstration: "Our working dogs are athletes and we wanna make sure, just like human athletes, we stretch and we make sure we're ready to do the job we're working, we wanna make sure our dogs are ready as well". When the dogs who graduate in careers outside the domain of bio-detection are purchased by external organisations, their new handlers are given training in the Fit to Work programme. As Sue insisted, "it's too important and we don't want it to stop."

[37] See chapter 5 for an ethnographic vignette of a grooming encounter between an intern and a dog.

For many interns, working closely with the dogs also had a transformative effect with regards to their own lives. One intern in particular, Joe, a reserved but diligent science student from a nearby university, stood out in this regard. Throughout my time at the center I had watched him grow in confidence as, over time, he was entrusted by trainer Jen to handle 'her' dogs during training, exercise, and grooming activities. Gradually he became less introverted when working with the dogs: for instance, altering the pitch and tone of his voice with confidence, to command a dog's attention. Nevertheless, it was not easy to grasp how much Joe really enjoyed this work as he did not give much away. At the end of his university cohort's six-month co-op placement at PVWDC, a pizza party was held at lunchtime, as a thank you from the center to the group for their efforts. Sue, the center's Training Manager invited each student to reflect on and share their experiences at the center with the rest of the staff and volunteers. When it was Joe's turn to speak, nobody expected him to reveal what he did. He informed that he had made the decision to apply for veterinary school, a prospect he had not even considered before spending time working with these dogs.

Later in the week I spoke with Sue, about Joe's revelation and she recalled her reaction, explaining, "My mouth dropped 'cause he wasn't the one I suspected who'd been impacted by us 'cause he's so quiet and just sort of steady as he goes, y'know?" Reflecting on how such personal change and growth can occur in this context, Sue emphasized the center's ability to cultivate independence and confidence among its volunteers:

> "It [interning or volunteering at PVWDC] absolutely changes people's lives. I think it's so different of a work environment. I think it could change lives for a lot of reasons, not just career. But I think that if you can come in and adapt in here, it requires you to really be somewhat independent. Yes, you rely on us telling you what to do, but if you're a wallflower, you will get nothing out of being here. And if you can be a little braver, I tell people when I see them, 'If you don't ask, if you don't follow people around, if you're quiet, this isn't gonna work. You gotta speak up, you gotta come out of your shell.'"

Significantly, at PVWDC, interns and volunteers do not merely watch the training sessions from the sidelines: gradually, they are offered the chance to handle dogs themselves. From the insights emerging from my observations as well as my personal experiences, as a researcher-come-volunteer, of handling bio-detection dogs in training, I

would suggest that the personal transformative potential of this work is also connected to one's own sense of agency that is routinely re-confirmed in the flow of human–dog interactions. These interactions can range from the mundane to the extraordinary: from teaching a young dog to sit on command, to handling a dog as he successfully detects the odour of prostate cancer. In emphasizing the role that a recognition of one's agency plays in affecting transformation among volunteers who learn to handle the dogs, I draw on Olga Solomon's (2010) study of the role of dogs in mediating the social engagement of children with autism, to propose that the detection-dogs in training, as communicative partners, give the people working with them a sense of 'aliveness' (Ibid., 147) that is reflected in the dog's actions.

During an interview with me, PVWDC founder, Cynthia, contemplated this life-altering capability that resides in encounters with the center's dogs:

> "The dogs unlock some of the human capacity, I mean, I've seen people come here and it totally change their world. It's really powerful. It's really important what the dogs can do and working with the dogs can do to give people a new sense of meaning and direction and maturity…they know what they're doing has such an impact. It's a meaningful thing."

In this section, I have demonstrated that the relationships between volunteers and dogs involves practices of care and assumptions of responsibility that can promote relationships perceived in terms of kinship and companionship. Furthermore, I have argued that the transformative potential of bio-detection dogs extends beyond the lives of the unwitting cancer sufferers who have been alerted to their disease by their dog—whose stories are retold by those seeking to refine this practice—and indeed the future patients whose lives might be saved due to enhanced diagnostic technologies. In various ways and at different scales, the lives of the people who live and work closely alongside these dogs are transformed.

v. Conclusion

As a whole, through introducing the reader to the practice of training bio-detection dogs, this chapter has highlighted how the labour of bio-detection dogs and the particularities of the odour they are tasked to detect, sets them apart from that of other kinds of assistance

or detection dogs. Although the principles guiding their work overlap with the labour of detection dogs in the more familiar specialties of explosives or drugs detection, as well as assistance dogs trained to detect the odour of low blood sugar levels in persons with diabetes, in several significant ways the domain of bio-detection is distinct. Firstly, these dogs detect odour in controlled settings for short periods of time each day, living akin to pet dogs during evenings and weekends, and secondly, the odour they are trained to detect is surrounded by greater ambiguity than the majority of more conventional odours dogs are employed to detect.

This chapter has also introduced several of the multiple and overlapping ways in which the dogs are understood, treated and represented by the various social groups with whom the dogs' lives are embedded. These representations include life-saver, statistical unit, worker, pet, kin and companion, and will be further teased out throughout the subsequent chapters, becoming a focus of analysis later in the thesis.

With the broader context of the practice of bio-detection dogs made familiar in this chapter, the ethnography proper begins in the next chapter which focuses on the shape of connectedness that is cultivated between humans and dogs in the specific training practices employed within my field sites.

Chapter 4. Cultivating 'a Dialogue Not a Monologue' in Bio-Detection Dog-Training

In this chapter, I examine the shape of human–dog connectedness in the context of training. After outlining the pedagogical approach adopted by my trainer informants, I examine how the dogs and humans are simultaneously engaged in affective relations that must be carefully cultivated in order to produce proficient bio-detection dogs, skilled handlers and 'good' data.

i. From Servants to Partners: A Paradigm Shift in Dog-Training Pedagogy

In the main training room of PVWDC, a group of high-school students on a morning tour of the center watch as an intern guides a German Shepherd through his 'Fit to Work' exercises.[38] The intern can be heard regularly praising the dog and seen feeding him kibble treats as he moves his body into bows and frog-like positions. Meanwhile, Sue, the Training Manager, gives the visiting students some information about the methods they use to train the dogs here, distinguishing their practices from earlier approaches to dog-training:

> "In early dog-training, if you go back and look at some way old dog books, you'll see that we [dog-trainers] used a lot more of what's called 'compulsion', where we used choke chains and more force training dogs. And you really couldn't do a lot with little puppies 'cause you could shut a puppy down. You could break a puppy. But because we use positive reinforcement we can get very young dogs to do lots of great behaviours. And so, it's all about building their confidence."

Across the world, and throughout history, there exist multiple, varied approaches towards training dogs. The specific methods adopted are intimately tied to perceptions of the dog, and both shape, and are shaped by, particular imaginations of human–dog relationships. While concepts of how to treat and teach dogs can be traced back to antiquity (Pregowski 2015), the boom of contemporary dog-training began just over one century ago, led by Prussian police colonel Konrad Most (1910). Most's approach to training illustrates his understanding of the principles of operant conditioning that were not popularized by

[38] See note 36 for an outline of the Fit to Work programme.

Burrhus Skinner until almost thirty years later (discussed in greater detail below). The techniques Most advocated emphasized forcing obedience on dogs using corrections and punishment (e.g., sharp tugs on the choke collar). Such methods reflected his conception of the relationship between humans and dogs as one of master-servant. Throughout the twentieth century, discipline and dominance continued to characterize popular training methods.[39] Whilst approaches that moved away from compulsion and submission were evolving at the same time[40], these struggled to achieve significant popularity, especially following the end of the second World War as soldiers returned home equipped with the training methods developed by Most.

This ostensibly human-centered approach to training has its roots in a now outdated assumption that the dog, perceived as a 'wolf within the home', must learn to obey his human master who is the pack leader. However, recent scientific research has debunked assumed ideas about the behavioural similarities between dogs and wolves, instead indicating fundamental differences between the species *Canis familiaris* (the domestic dog) and *Canis lupus* (the gray wolf) (e.g., Coppinger & Coppinger 2001; Miklosi 2007).

Since the 1980s, scientific research in ethology and psychology has increasingly informed methods of dog-training, and the field has become progressively professionalized. For instance, today dog-training is largely dominated by individuals with scientific backgrounds, including Karen Pryor (behavioural biologist), Dr. Patricia McConnell (ethologist) and Dr. Roger Mugford (animal psychologist). Abandoning 'traditional' human-centered methods that consider the dog as subordinate and rely on force and compulsion, this new era of dog-training is characterized by its emphasis on 'positive training' through the reinforcement of desired behaviour using rewards that are considered desirable to the dog.[41] Accompanying this pedagogical shift, has been a

[39] For instance, see William Koehler's (1962) manual, *The Koehler Method of Dog-Training*, supposed by Gail Fisher (2009, 8) to be 'the all-time best-selling dog-training manual' in the United States.

[40] For instance, in the 1940s, Keller Breland, a graduate student of Skinner, pioneered the use of the clicker as a sound to mark the desired behaviour and bridge the time between the behaviour and the delivery of the reward, or reinforcement (Fisher 2009, 8).

[41] Notably, these changes in attitudes and thinking around approaches to dog-training resemble broader societal shifts in attitudes towards education and the treatment of children and persons with disabilities across western societies. In these contexts, physical punishment has increasingly been recognized as ineffective and cruel and is reflected in UK law, with corporal punishment against children outlawed in 1986 in British state

renegotiation of the role the dog is able to play in the training process, with training becoming more dog-centered (Koski and Bäcklund 2017, 14).

In both of the dog-training pedagogies that I have outlined—the human–centered approach emphasizing punishment for unwanted behaviours, and the dog-centered, or reward-based, 'positive' approach that prioritizes the positive reinforcement of desired behaviours—Skinner's (1938) behaviorist theory of 'operant conditioning' is fundamental. Briefly summarized, operant conditioning focuses on the *consequences* of a behaviour. Skinner notes that the consequences of a behaviour can be either *punishment* or *reinforcement*. Punishment is any consequence which reduces behaviour, whilst reinforcement is any consequence which increases behaviour. For each of these consequences, there exist two distinct categories: *positive*, whereby a consequence is added to the dog's environment; and *negative* whereby a consequence is removed. Thus, there are a total of four quadrants of operant conditioning: positive reinforcement, negative reinforcement, positive punishment and negative punishment. Notably, the use of 'positive' and 'negative' refers to the mathematical definition, rather than value-judgments. The four quadrants of operant conditioning are summarized in a table (Figure 3) which featured on a handout I was given during my induction as an intern at PVWDC.

schools. The ban took longer to come into force in private schools, but by 2003 it was enforced throughout Wales, Scotland and Northern Ireland. Punishment was replaced with behavioural procedures focused on reinforcement.

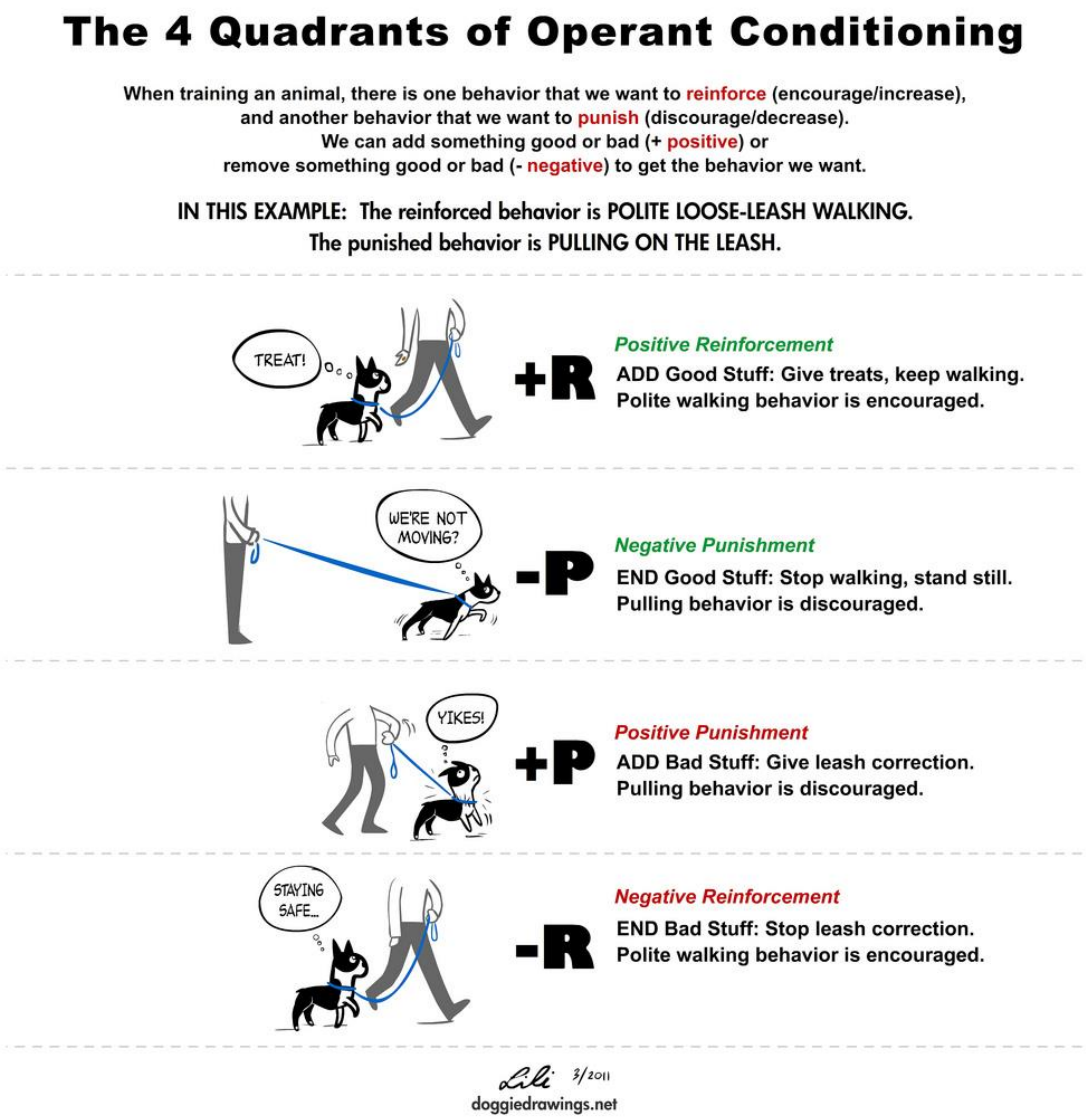

Figure 3. 'Learning Theory' © 2014 Lili Chin, licensed under Creative Commons. This diagram that featured in my enrollment literature as an intern at PVWDC explains the four quadrants of operant conditioning.

Consistent with the current trend for 'positive training', the dominant category or quadrant I observed among my informants in both organisations, and which I was taught to adhere to myself whilst handling dogs, was positive reinforcement. An emphasis on positive reinforcement confers certain obligations of 'response-ability' (Haraway 2008) on both partners (human and dog) of the training relationship. Following Haraway (Ibid.), 'response-ability' refers simply to the ability to sense and respond to the needs of another: an essential sensibility for interspecies cohabiting. In this context, response-able relations are also essential to the production of a proficient detection dog–trainer dyad: comprised

of a dog who makes 'good' choices and a trainer who is able to read and communicate with the dog.

'Positive training', or training that places an emphasis on positive reinforcement, is an approach that is characteristically 'all about rewards' (Pregowski 2015, 530). Rewards come in various forms, including edible titbits, verbal praise, toys, play, and physical touch (i.e., patting and stroking).[42] As the dog performs a desirable behaviour, the trainer immediately 'marks' this behaviour as correct by generating a sound produced by a 'clicker': a small, hand-held tool activated by pressing one's thumb down on the device to produce a short, sharp, repeatable sound. The sound is then followed by the provision of a reward. Thus, in the context of detection training, clicks and rewards are given following a dog's indication of a positive sample, or an 'all-clear' response to a blank lineup.[43]

It is notable that food, toys and affection (in the form of verbal praise and touch) are not restricted to training encounters, but are provided to dogs at other times throughout the day. Each dog is given the same portion of food per day—calculated in relation to his age and weight—regardless of whether he receives additional food as treats during work. Toys are played with during other times of the day too, both at work and at home. Furthermore, dog-directed speech and touch are frequently observed among the trainers and volunteers. Thus, it is not the case that these dogs are required to 'earn' fundamental resources that are otherwise withheld. Instead, conceptualizing their odour-detection

[42] The type of reward used differs depending on the training activity. Typically, food (e.g., kibble, hot dog pieces, chunks of cheese) is used as a reward in bio-detection tasks, whereas toys are more commonly used when training to find missing people, explosives, or drugs. In the task of disease detection, dogs tend to be required to repeat the same task many times during one session, thus making multiple 'finds' throughout a single training period. Therefore, there is a need for the dog to remain focused after each find. The way toy rewards are given to dogs encourage excitement and play, therefore making this kind of reward unsuitable for bio-detection tasks. However, marking the *end* of a bio-detection training session, toys (and the associated play) are often used to reward dogs.

[43] Dogs at MDD are trained to clear lineups that contain no positive sample: referred to as a 'blank'. Whereas, detection dogs in more traditional areas (e.g., police and military search dogs) tend to only get rewarded for making a find, MDD train dogs using what they call a 'balanced reward system'. In this system, dogs are rewarded both for making indications at positive odour samples and also for giving an 'all clear' indication after searching a lineup of control samples. This is believed to reduce false positive bias, or instance of dogs indicating at control samples.

activities as a kind of labour, the rewards they receive might be better conceptualized as 'bonuses'.

Despite its predominance however, positive reinforcement is not the only type of operant conditioning employed in my field sites. This is consistent with the trend of 'positive training' which, while far from homogenously practiced, typically combines positive reinforcement and negative punishment, with an active eschewal of the other two quadrants.

Among my informants, negative punishment is most often used in conjunction with positive reinforcement as in the case of teaching 'polite' loose-leash walking. In this training task, the goal is for the dog to walk alongside the human without pulling on the leash that is attached, at one end, to the dog's collar and held onto at the other by the handler. For example, when Jen, a trainer at PVWDC, taught me how to walk dogs in line with PVWDC protocol, she demonstrated with Jackson, a four-month-old German Shepherd puppy, to show me what I ought to do if Jackson pulls. I joined her for a potty-walk with Jackson, around the campus on which PVWDC is located. The campus, located across the river from the city and adjacent to a waste management station, consists primarily of several dilapidated buildings and a bus parking lot: a rather grey and uninspiring site in my estimation. Nevertheless, the site provides plenty of interesting distractions for a young dog: moving cars and buses, birds flying low, pieces of rubbish blowing in the wind, people walking, stray cats, and other dogs.

As I walked with Jen and Jackson, I observed how each time Jackson pulled on the leash, Jen stopped walking and stood still, waiting until Jackson stopped pulling and for the slack in the leash to re-emerge. Only when the leash loosened, would she begin walking again. In this instance of 'negative punishment', walking temporarily ceases ('negative'), Jackson is temporarily prevented from getting what he wants (moving forward) and the likelihood of him pulling on the leash (i.e., repeating the undesired behaviour) is reduced ('punishment'). When Jackson is walking 'politely' on a loose-leash alongside Jen, she offers him verbal praise such as "Good boy!", "Nice!" and "Yes!" and rewards him with small pieces of kibble (positive reinforcement) taken from the treat pouch attached to her waist.

Significantly, I did not observe the use of physical corrections or force that would constitute the quadrant of positive punishment (or, by association, negative reinforcement) at either site. Thus, in their methods, these organisations explicitly follow the current trend

towards positive training that advocates positive reinforcement as the most prized category of operant conditioning and steers clear of compulsion techniques.

The abandonment of traditional approaches to dog-training in the move towards heavily reward-based training, and the more recent ideological shifts that have altered the definition of the human–dog relationship are changes that have been personally experienced by several of the older trainers at both MDD and PVWDC. Earlier in their dog-training careers with other organisations, and in keeping with the training styles advocated by these former workplaces, several of the trainers employed human-centered training methods comprised of force and compulsion. Articulating why they used these methods that are at such odds with their current training styles that I observed them practice, trainers frequently told me that 'it was just how things were done back then'. For example, I spoke to Ed, a trainer at MDD, about his previous workplace, an explosives detection business where, as he told me, "Checking leads[44], checking collars, and yelling" were all commonplace. Ed explained why he had adopted these particular methods at the beginning of his dog-training career:

> "Going in green [i.e., as a novice dog-trainer], when I was working at K9Search[45]…you don't see anything outside those boundaries. So, going there and seeing bits and parts of it, you do naturally start doing whatever people do 'cause it's the only way you learn. But moving on, you read, you learn to go to conferences, you learn other people's ideas and you realize it's not the best way to do things."

Learning through observing others, as Ed mentions, is a fundamental aspect of how dog-trainers build up a large amount of their tacit knowledge with regards to training and handling dogs. Cynthia at PVWDC shared similar sentiments about popular training methods of the past, reasoning that "people were doing things because that was what they learned from somebody else and that was what they thought was the best. But we didn't really know, and so just getting some data behind it was important." In the accounts of both Ed and Cynthia we see how their sense of response-ability, in relation to the dogs,

[44] 'Checking' a lead refers to applying a sharp yank on the lead.
[45] Pseudonymn used.

has been revised in response to the development of knowledge about dog-training methods and the dog's cognitive capabilities[46], highlighting response-ability as a learned and unstable practice influenced by dominant cultural discourses.

The current trend for 'positive training', as practiced by my informants and outlined in this section, depends on an understanding of the dog as a sentient individual. This has implications for the way the trainers communicate with the dogs, as examined in the following sections.

ii. Listening to What the Dog Tells You

In this section, it will be shown that rather than treat the dogs as passive animals or 'black boxes', the trainers' interactions with the dogs are based on an assumption of the dogs as beings who can 'speak' to them, if they are willing to make themselves available to listen. During an interview with Alexa at MDD, in which she reflects on the attributes that that she considers comprise a successful dog-trainer in bio-detection, she emphasizes the importance of learning to communicate with the dogs in modes that they, as beings without verbal language, can understand. Fundamentally, she laments that trainers have to 'listen':

> "You have to understand why they're doing what they're doing and how to harness everything that they have. It's very much working with them to work out what their reason or drive is for doing it, to sort of harness that so you can get the best working relationship…Even though they can't speak English, you still have to communicate with them. You still have to sit and listen and work out what it is they understand and don't understand. So, if you're doing positive training you have to learn lots of different ways to listen to a dog, so you can learn different ways to communicate to them…If you're not listening to them and you're not talking to each other you would end up resorting to physical methods because

[46] A wealth of data about dog-training methods has been gathered over recent decades, supposedly revealing the benefits of positive reinforcement (e.g., Hiby et al. 2004; Blackwell et al. 2008). This emergent body of research, combined with the continued growth in academic research surrounding the cognitive capabilities of dogs (e.g., Hare et al. 2012) have been key to the growing popularity of the trend for positive training.

you're not getting anywhere because you're not listening to what they're saying. If the dog doesn't understand how to sit it's because you've not taught it to sit."[47]

Implicit in Alexa's account is her desire to understand the individual dog on his own terms, as a being who, despite lacking a shared verbal language with humans, is certainly not mute nor unable to respond. Her insistence on the verb of 'listening', to describe human–dog communication is intriguing, given that, as she explicitly recognizes herself, dogs do not speak in verbal utterances. Reflecting on this linguistic choice, I consider that this might highlight the lack of non-humanistic everyday vocabulary available to dog-trainers: a reflection of the deeply ingrained divide between human and animal entrenched in western culture, which has arguably led to a deficiency of more appropriate modes of speaking about our communication with animals.[48] However, while dogs do not speak in verbal utterances akin to humans, they are highly communicative in nonverbal ways, as Alexa clearly acknowledges. Thus, it is possible for trainers to pay attention, or 'listen', to what a dog has to say, whether a dog is gesturing with his body, or at other times, through the sounds a dog produces. Indeed, dogs are not silent. Some examples will help to give a sense of how 'listening' to the dogs is performed in practice.

Midway through a training session with a young dog at PVWDC, an intern came into the room holding a plastic pot and set it aside on some shelving low to the ground, a couple of metres away from where the dog and her trainer Tash were working. After a minute, the dog walked over to the item and sniffed at it for a few seconds. Watching the dog, Tash asked the intern "Is that dirty?" He confirmed that yes, it was contaminated with the

[47] Locating the fault of a dog's misunderstanding with the human, rather than the dog illustrates a reoccurring and significant theme in how my trainer informants conceptualize dog-training. For them, it is a practice in which the human partner is obliged to adapt their communication to the specificity of a particular dog. Rather than conceptualising the dog as being unequipped with the linguistic tools of human communication, it is the human who is seen as the species lacking and requiring ongoing self-work.

[48] The notion of 'listening' to dogs, who do not speak in verbal utterances, mirrors a discrepancy of language used by trainers to describe the dog's smelling behaviour. For instance, trainers often refer to the dog as having 'seen' the samples, rather than having *smelt* them. I suggest that this is a consequence of the low status of smell in western culture, compared to the sight which has been valorized. See chapter 1 for an outline of the shifting status of smell in western culture.

training odour used to teach puppies the game of scent-detection. Tash clicked her clicker, marking the dog's behaviour, and rewarded the dog for showing interest in the item. "No wonder she's hitting on it," Tash said, "you're not wrong girly!"

Furthermore, experienced trainers who spend extensive periods of time with individual dogs learn how to read the nuances of their dogs' body language in order to grasp something more about the details of the particular odours:

When working blind, Ed, at MDD, was able to infer with considerable reliability the particular characteristics of the control samples presented to Lola. Ed and Lola were training for a study to detect a particular bacterium and their positive samples comprised laboratory grown bacteria suspended in a broth, while control samples were a combination of pure broth and broth with specific antibiotics. Observing how Lola moved her body away from the control samples over numerous training sessions, Ed learnt that Lola would typically come away from the sample very quickly, turning her body to the right, after sniffing a control of pure broth, whereas when the control contained broth plus an antibiotic, Lola would turn the other way.

By carefully 'listening' to their dogs by affording attention to the nonverbal, these examples illustrate how trainers are able to arguably supplement their own olfactory capabilities with those of the dog, thus momentarily expanding the corporeal limits of their body. In effect, with the dog acting as a 'mediator between the human and inhuman worlds of nature' (Pemberton 2013, 74), the trainer may come to share aspects of the environment that are generally inaccessible to him beyond his engagements with the dog. At the same time, in the process of learning to become affected by odour in novel ways, the dog engages with new possibilities for shared meaning-making with his trainer.

With individual quirks such as Lola's, offered in response to the different samples, it is imperative that trainers refine their ability to read the bodies of their individual dogs in order to correctly interpret the particular dog's response to each odour sample. Although dogs are typically trained to sit in response to their target odour, this 'alert response' is variable both between dogs and within the individual.

For instance, during a training session at MDD, Lola offered some ambiguous search behaviour that Ed was obliged to make sense of. Lola represents an unusual case at

MDD, as she is (at the time of my observations) the only dog trained to search a one-stand system. The trainers explained to me that in theory, the one-stand system should elicit one of two responses from Lola: either she stays at the stand to indicate a positive sample, or she turns and returns to her trainer to indicate a control sample. Having observed Lola work and listened to those who routinely handle and observe her, I quickly learnt that Lola is known to sometimes raise her paw when interrogating samples, most often when the sample is a target, but sometimes also out of supposed frustration after a run of consecutive blanks.[49] As a result, her behaviour can be rather unclear to the untrained eye and requires the skill and experience of her trainer to interpret. To illustrate this, in the following example, the vignette begins as Lola is searching a target sample, though her trainer, Ed, is unaware of the sample's contents.

Sniffing the sample, Lola raises her paw to the arm and expresses a high-pitched vocalization. She then turns away from the stand and walks back to Ed's side, behind the screen. [As noted above, leaving the sample and returning to the trainer's side would, in theory, be a trained response to a control sample]. Ed comments to Kelly, operating the laptop, that he is not confident in making a call of indication or no indication, based on Lola's behaviour, and he elects to send Lola to search the sample again. This pass is recorded by Kelly as a 'hesitation' and she notes in the comments space on the laptop screen that Lola raised her paw before leaving the stand, causing uncertainty for the trainer.

"Seek seek," Ed calls out, sending Lola to search again. On this pass, Lola raises her paw again but then sits, offering her trained alert response. This time, Ed calls out "indication," and is informed by Kelly that this is correct. He clicks his clicker and rewards Lola at the stand. Ed and Lola then leave the room whilst I put out a different sample on the stand: a control.

Sample in place, I call out "ready" to Ed. He opens the door and says "come" to Lola, who walks into the room and sits at the screen, her starting position, waiting to be instructed to search. This time, as she investigates the sample, Lola raises her paw towards the stand, begins to bend her legs and move her bottom towards the floor, but before committing to a full sit she comes away from the stand and returns to Ed's side behind the screen. Ed calls "clear." After telling him this is correct, Kelly asks, "How did you know

[49] See note 43.

not to call [indication] on that?". Ed replies, "There wasn't all the huffing and puffing. It's not something I can really explain, it was just different. With some dogs, you just know."

In the first run detailed above, Ed was proven correct in his suspicion that Lola had offered an incorrect response to the sample, as on her second pass she correctly indicated that the target was there. At MDD, if trainers are not confident in making a call of 'indication' or 'no interest', they are permitted to task their dogs to search the lineup again. This example illustrates that, as behaving beings, dogs do not always respond in predictable and clear ways. Thus, in order for a trainer to make accurate judgments, trainer skill and experience in reading dogs, as well as a strong relationship between trainer and dog are necessary conditions of this work. Ed displayed his skill as a trainer again on the subsequent run presented above (the control sample), where Lola raised her paw in a similar manner to the way she had done on the previous target sample. With a working relationship with Lola spanning several years, Ed was able to pick up on the fact that in Lola's subsequent run, among other things, she was less noisy than she had been previously.

Ed's account of Lola's behaviour illustrates that although much 'listening' is focused on a reading of the dog's body as it is *observed*, the dogs' bodies are also listened to in the literal sense: with particular attention afforded to the sounds produced by the dog's nose and mouth.[50] Given the primacy of the dog's olfactory capacity in the context of bio-detection, these aspects of the dog's body are afforded special attention due to their association with sniffing behaviour. This focus is regularly explicit in the dialogue between trainers during training sessions. For instance, "Did you hear that?" referring to a dog's inhalation or exhalation of breath, or, "She just cleared her nose, that's good." Comments such as this were commonplace in the training spaces.

For the trainers, the sounds dogs make when searching are not only a functional matter, informing their understanding of a dogs' engagement with his environment. More than this, they can also evoke an emotional response in the trainers, highlighting the affective dimension of this work. For example, during a presentation about his work that he gave to the staff and interns at PVWDC, a visiting arson detection dog handler professed, "There's not a better sound in the world to me than to hear the dog. You can

[50] Dogs have a second nose at the back of their throat called the vomeronasal organ, or the Jacobson's organ, mainly used to detect pheromones.

hear the [he sniffs in and out, exaggerating the sounds that this produces]. It sounds like an old coal train getting ready to take off. You can hear that inhaling, exhaling."

The sounds associated with olfaction, combined with their readings of the dogs' bodies, provide the trainers with information about a dog's search that they are able to interpret, highlighting one aspect of the 'skilled bodily craft' (Cassidy 2002, 106) that is essential to successful dog-training. Referring to the production of racehorses, Rebecca Cassidy (Ibid.) proposes the notion of skilled bodily craft to describe the stable staff's skill involved in understanding horse behaviour and in communicating with these animals, without which racehorses simply could not be 'produced'. Furthermore, the dog-trainers' ability to interpret their dogs' behaviours, despite its occasional ambiguity as in the above example of Lola and Ed, highlights their dependence on a tacit mode of knowledge that largely defies linguistic representation. Ed's difficulty verbally articulating quite how he knew not to call 'indication' on the second run, despite Lola continuing to display some hesitant behaviours at the odour sample, resembles the way Cassidy (Ibid.) describes skilled bodily craft in the case of horse-riding. In this context, Cassidy notes that riding, as a skilled bodily craft, 'provide[s] a structure for experience in which linguistic explanations for action are excluded by the immediacy of physical involvement' (Ibid.).

Whilst paying attention to the animal's body to gain a more sophisticated understanding of the individual's experience is increasingly popular in approaches towards training animals more broadly, as well as engaging with them in research (Greenhough and Roe 2011), I argue that this takes on an even greater significance in the particular context of human disease detection. This is owing to the enigmatic and assumed inconsistency of the odours that are being presented to the dogs. For instance, Simon is explicit in linking the trainers' ambiguity surrounding the odour of human disease, and the requisite as a trainer to listen to 'what the dog is telling you':

> "When we're talking about odour, we're always trying to surmise what a dog is smelling, what a dog is indicating. And we're always trying to second guess what the next step is for a dog. The only one that can tell us, whether that guess is right, is the dog. So if the dog is transitioning through the training, i.e., we introduce it to stage one cancers because we think that's the best way to do it, and the dog is completely erratic in its detection, we say 'Oh well then we can't be thinking the

right thing'. The dog is telling us that stage one isn't the easiest thing to do…Well that is in itself an answer. The dog is telling us that something's not stable."

Here, Simon explains how the trainers depend on feedback from the dogs to help them understand if they are making reasonable decisions with regards to how to best introduce the samples, in order to facilitate a dog's learning. Specifically, he is referring to their need to develop an understanding of whether is it easier for the dog to learn to discriminate 'diseased' from 'healthy' samples by categorizing and presenting them according to tumour size, Gleason score, or something else that they have not yet considered meaningful. Evolving their knowledge and methods based on what the dogs 'tell' them, the trainers thus express a desire to know what matters most to the dog: the species with the superior olfactory capabilities.

This notion outlined above, of listening to 'what the dog tells you' in order to gain a better understanding of how to present odours that are largely enigmatic and unavailable to human perception, was regularly alluded to by my trainer informants at MDD. For instance, during a team meeting one afternoon, doctoral researcher and dog-trainer Gemma was outlining, to her colleagues, her method for selecting the order in which to present particular samples to a dog, in order to help them learn the odour of the particular disease. She listed logistical factors, such as: sample availability; biographical issues, including the particular dog's performance in the previous weeks; and the goal of the session, for instance, introducing the dog to a new target sample. However, concluding her reflections about this process, she echoed Simon's sentiments, asserting that "The *only* way you can choose samples is by what the dog tells you." Thus, while various other factors come into play, the dog's perspective is ultimately prioritized here, in part due to the uncertainty that surrounds the odour of human disease. Emergent here then is a sense of the agency the dogs have in shaping the material reality of this work.

Explicit in this everyday practice of listening and responding to dogs are some of the trainers' perceptions about what separates humans and dogs, as well as their assumptions about how the species boundary might be navigated through their practices. While overtly recognizing physiological fundamental elements that distinguish the capabilities of each species—the differences in olfactory capability and the unequal capacity for verbal communication—they simultaneously profess both a desire and ability to harness

something of the dog's perspective through training practices that demand response-able relations. As Simon explained:

> "They've got a far superior capability of olfaction, so why should we say that they're wrong when they know more about what they're sniffing than what we do? So they will tell you, or try to communicate with you. What you're trying to do is empower the dog in a certain way, to say 'we are as equal' in this: 'I am able to tell you when you're right, or when I think you're right, and you're able to tell me whether I'm thinking right'. Somewhere along the line we'll come to an agreement about it."

Readily acknowledging the dog's 'superior capability of olfaction' in relation to (hu)man, and describing the training process as a means towards developing interspecies 'agreement', Simon's account presents a challenge to notions of 'human exceptionalism' (Haraway 2008) that pervade western cultures.

While the work of bio-detection dogs is based on a fundamental separation between the capacities of human and dog, the training practices through which such work is achieved both supports and obliges the navigation and overcoming of such a separation between the species, promoting the development of a specific human–dog connectedness. By listening to the dogs and prioritising their experience, the trainers and dogs work together to cultivate what Ed described to me as a 'dialogue, not a monologue': the phrase he regularly used to describe his understanding of best training practice.[51] In encounters based on interspecies dialogue, it becomes possible for the assumed limits of the human body to be expanded, with the dog as a mediator of the olfactory and the human momentarily supplementing his olfactory capabilities with those of the dog.

Whilst this section has illustrated how trainers become attuned to the bodies of their dogs, in the following discussion I turn to consider how the dogs are simultaneously affected by their trainers' actions and what a recognition of this means for the trainers' practices.

[51] This phrase is borrowed from Susan Friedman, an American psychology professor who introduced the application of Applied Behavioural Analysis—a method with roots in human learning—to captive and companion animals.

iii. Looking and Being Looked At: Affect in Training Encounters

> [L]earning how to address the creatures being studied is not the result of scientific theoretical understanding, it is the condition of this understanding. (Despret 2004, 131)

Although the discussion has, until now, focused on how trainers observe the dogs, it is also the case that the dogs watch the trainers. Acknowledging this obliges the trainers to perform specific acts of bodywork in order to monitor and manage the affective potential of their own bodies. Here, I consider how these practices shape a particular human–dog connectedness that supports training in this context.

While the role of smell cannot be underestimated, with regards to dogs' engagement with their environment, dogs know and communicate with humans not only through smell and touch but also through watching us; in particular, following our gaze and our bodily movements (Horowitz 2010). When not working, exercising or napping, the dogs in my field sites constantly watch every move of the bodies (human and canine) visible to them. At MDD, during training sessions, dogs often watch through the wall of glass that separates the training room from the viewing gallery, observing the flow of interactions between a dog and trainer (Figure 4).

Figure 4. At MDD, bio-detection dogs watch, through a glass wall, as another dog and his trainer (to the left, out of shot) participate in a training session using pots on the floor.

The importance of visual cues for dogs' interaction with the world is supported by a growing body of 'dog cognition' research that explores dogs' cognitive and sensory abilities, illustrating in particular the significance of eye contact, or 'looking', between humans and dogs for interspecies communication. Studies have found, for instance, that dogs are highly skilled at following visual cues such as human pointing or human gaze (Miklosi, et al. 1998).

With regards to facial recognition, when looking at photographs of human and dog faces, dogs can discriminate between faces of familiar or unfamiliar humans and dogs, even when only shown a part of the face (Racca, et al. 2010). Furthermore, research suggests that dogs can recognize human emotions, telling the difference between happy and angry human faces (Müller, et al. 2015). Building on this finding, a more recent study (Albuquerque, Guo, Wilkinson et al. 2016) demonstrates that dogs are able to go further than simply recognizing facial cues. Pairing images of faces and sounds, the results of this study suggest that dogs must form abstract mental representations of positive and negative emotional states: in short, they have the capacity for the perception of emotion, in both humans and dogs. This is the first time this ability has been recognized in animals beyond humans. Indeed, so apt are dogs thought to be at reading humans, Horowitz (2010, 161)

describes them as ‘canine anthropologists’ and notes that ‘we are known by our dogs—probably far better than we know them’.

Aware of the dog’s dependence on visual cues and their capacity to recognize subtle changes in human bodies, in certain situations, the trainers draw on an important element of their toolkit: their own bodies. I observed how the trainers routinely adjust their own bodies in particular ways to affect the dog who they are training. Affecting each other somatically, the human–dog dyad thus overcomes the potential challenges associated with the absence of a shared verbal language. The following observation taken from a training session at MDD, with Cocker Spaniel Zak, illustrates how physiological cues are, at certain times, intentionally offered by trainers, with the goal to shape how a dog moves his body, or acts, in certain situations.

Between runs, Zak’s trainer Alexa discusses with her colleague, Ed, the excessive speed with which Zak is searching the positions of the carousel. They are both concerned because in their experience of training, searching with such speed can reduce detection accuracy. Alexa wants Zak to slow himself down and after rewarding him for his subsequent successful search, I watch her adjust the movement of her own body to achieve this. Making eye contact with Zak, she says, “You need to calm yourself, mister.” The pair then walk back across the room towards their starting position. As she walks, Alexa exaggerates each step, taking more time to make every small move. This style is quickly mirrored by Zak. As they walk side by side in synchrony, she offers him reassuring verbal feedback, “Good boy… nice,” delivered in a soft, calm tone that matches the slow pace of her movement.

Thus, we see how the dog has learnt to be affected (Latour 2004): affect that, in this case, is mediated by the subtleties in the movements of the human body and the dog’s aptitude in reading and responding to this human body language. Despret’s (2004) understanding of affect, as a dynamic process taking place at the meeting of a diversity of bodies, can help to theorize this training encounter and recognize the operation of nonhuman agency here. As Despret insists, it is not only human bodies that can be made to move and be affected, but also the bodies of the animals themselves that can cause human bodies to be affected. In this encounter, Zak, the dog, ‘could make human bodies move and be affected’ (Ibid., 113). In Alexa’s desire for Zak to slow down, and in her broader aim to help him become a reliable detection dog, she adjusted the movement of

her own body to affect Zak. In effect, in this training moment, the bodies of dog and human became 'attuned' (Despret 2004) to one another.

Aware that dogs 'look back' (Haraway 2008, 21), dog-trainers extend a curiosity about the dogs, that is not a ubiquitous feature of human–animal relationships, particularly in contexts of scientific practice. Especially in a western tradition of philosophical and scientific thought, humans have largely failed to extend their curiosity to animals, tending instead to think of them as part of the background, as symbols or as raw material for human consumption (e.g., Evans-Pritchard 1950; Geertz 1973; Levi-Strauss 1963). For Haraway (2008) however, curiosity about the nonhumans with whom we interact is a critical component of her 'companion species' rubric.

Haraway (Ibid., 19-27) illustrates the variability of how curiosity figures in human–animal relationships and representations of animals, by fruitfully contrasting two distinct experiences of human–animal encounter. First, she turns to the philosopher Jacques Derrida who, in his 1997 lecture 'The Animal That Therefore I Am (More to Follow)', describes an encounter between himself, stood naked in his bathroom, and his cat. Derrida notices that the cat was looking at him and he raises a question that Haraway considers key: that is, 'not whether the cat could 'speak' but whether it is possible to know what *respond* means and how to distinguish a response from a reaction, for human beings as well as for anyone else' (Haraway 2008, 20). However, whilst Derrida clearly understands that animals do look back at humans, Haraway criticizes him for falling short of a basic obligation of companion species: she writes that 'he did not become curious about what the cat might actually be doing, feeling, thinking, or perhaps making available to him in looking back at him that morning' (Ibid.).

However, it is also possible to observe alternative modes of experiencing researcher–animal relationships, whereby researchers actively 'make themselves available' (Haraway 2008, 20) to the animals of study. In order to clarify what it might look like—and what potential opportunities might become available—when one becomes curious about the animals with whom one encounters, Haraway juxtaposes Derrida's account of his encounter with his cat with the work of Smuts (2001), a primatologist who has studied baboons in Kenya since the mid-1970s. According to Haraway, and in distinction from Derrida, Smuts is someone who 'did learn to look back, as well as to recognize that she was looked at, as a core work-practice for doing her science' (Ibid., 23). Trained in the traditional practices of 'objective' science, in which a process of

"habituation" of the animals to the presence of the humans has long been considered fundamental, Smuts entered the field with the intention to be as neutral as possible. However, Smuts quickly called this approach into question as she noticed that the baboons did not seem to be impressed by her attempt to render herself invisible. Furthermore, she was struck by how frequently they looked at her, with her efforts to ignore their looks only seeming to increase their dissatisfaction with her. Smuts was learning the importance, to the baboons, of responding to social cues. With this recognition, she altered her behaviour in order to respond, to acknowledge, to look back. She explains that in doing so, her own being was transformed:

> I…in the process of gaining their trust, changed almost everything about me, including the way I walked and sat, the way I held my body, and the way I used my eyes and voice. I was learning a whole new way of being in the world—the way of the baboon…I was responding to the cues the baboons used to indicate their emotions, motivations and intentions to one another, and I was gradually learning to send such signals back to them. As a result, instead of avoiding me when I got too close, they started giving me very deliberate dirty looks, which made me move away. This may sound like a small shift, but in fact it signalled a profound change from being treated like an *object* that elicited a unilateral response (avoidable), to being recognized as a *subject* with whom they could communicate. (2001, 295)

To develop a mutual acknowledgment that would permit both herself and the baboons to conduct their daily business, Smuts recognized that she had to consider not only what *she* was looking at, but also how the baboons were looking at and responding to her. As Haraway (2008, 25) writes, 'Smuts had to enter into, not shun, a responsive relationship'. Smuts' approach can help us to understand the curiosity that characterizes the relationships between trainers and bio-detection dogs. Within my field sites, the trainers constantly look at the dogs and acknowledge that the dogs look back at them. This is explicit in some of the routine remarks made between trainers during training sessions. For instance, "He's looking to you for help," Neil commented, referring to a dog who had paused mid-search and turned his head to look back to his trainer. Especially during the early stages of a dog's training process, I routinely heard comments along these lines.

The fact that the trainers acknowledge that dogs look back at them has implications for training practices that extend beyond the temporality of the particular training session.

For example, midway through a training session with trainer Kelly and Shadow, a Fox Red Labrador, Kelly disappeared momentarily into the charity's operations office, adjacent to the bio-detection department. She had gone to ask some of the staff from the fundraising team if they were free for ten minutes to come through to the bio-detection viewing area and watch Shadow work. Among the trainers, Shadow is known to be particularly sensitive to changes in his environment and Kelly knows that during the trial phase for the project Shadow is working on, there will be novel people (i.e., external collaborators) on site watching the dogs work. Thus, Kelly is keen to get him used to searching in front of an audience of people who he is less familiar with. Thus, more than merely acknowledge that dogs look at the humans in their environment, the trainers are clearly acutely aware that human bodies have potential to *affect* the bodies of the dogs: for instance, altering their disposition and, by association, their detection reliability.

However, whilst Smuts (2001, 295) explains that she felt obliged to learn 'a whole new way of being in the world' in order to gain the trust of the baboons, the dog-trainers who I spent time with did not reflect on their bodily adjustments in such radical terms. When I asked them to reflect on how they communicate with the dogs, they often explained it as an ability that comes instinctively to them. For instance, Alexa at MDD told me, "I don't know why, I just clearly understand dog."

Some trainers suggested that their childhood experiences might have helped them develop the ability to communicate with dogs with ease. As Sue at PVWDC mused during an interview, "Some people naturally communicate with dogs, I don't know if it's 'cause I've grown up with dogs I find it so easy and I find it so effective." For the trainers and dogs in the context of bio-detection, it seems that mutual trust and acknowledgment is achieved without explicitly learning a whole new way of being in the world. As the earlier example of Alexa and Zak shows, ostensibly instinctive and subtle modes of bodywork (Wolkowitz 2006) are often sufficient in providing communicative cues that the dog is able to make sense of and to elicit the response desired by the trainer. The relative ease with which many humans and dogs make themselves available to each other is arguably, at least in part, a consequence of the shared evolutionary history between these species, spanning tens of thousands of years.[52] Acknowledging this historical perspective helps us to understand why working and communicating with dogs might not require such a radical

[52] The exact date and location of dog domestication remains a controversial topic among scientists. See chapter 1 for an outline of the main theories of dog domestication.

process of self-modification, as might be required when a human learns to live alongside a group of baboons.

Paying attention, in this analysis, not only to how the dogs respond to the humans in training encounters, but also to how the humans respond to the dogs, helps to make clear that affect occurs at the *interface* of bodies (Massumi 2002, 25) and that multiple bodies are capable of being affected in a given encounter (Despret 2004). Thus, whilst the humans teach the dogs to become affected, it might also be suggested that dogs teach, or train, humans to become affected in certain ways.

It is affective encounters, Despret argues, that come to constitute the beings who meet each other. As Haraway (2008, 17) suggests with regards to her concept of 'companion species', 'The partners do not precede their relating'. Following Haraway, in this ongoing practice of 'becoming with' (Ibid.), training might be conceptualized not as a one-way endeavor in which the human exclusively compels the dog to act in a certain way, but as an activity that modifies both members of the training relationship. Despret (2003, 122) re-frames this practice of 'domestication' with the notion of 'anthropo-zoo-genetic practices' in which humans and dogs mutually constitute their relationships. In this process, novel identities and ways to behave are available to both partners.

Certainly, my interlocutors themselves expressed an understanding of their training relationships with the dogs as more mutually negotiated, rather than exclusively human-dominated, with a recognition that the dogs have the capacity to influence the humans in the training process. During an interview in her office, Cynthia described this to me in terms of a teacher–student relationship in which both individuals of the dyad adopt each of these roles at certain times. She told me that, in addition to learning and gaining skills taught by their trainer, part of the dog's 'job' at PVWDC is to "teach us what we're doing wrong or what we could do better."

Also challenging an assumption of these human–dog relationships as characterized by a unilateral flow of knowledge between beings structured by hierarchical ranks between human and animal, Simon reiterated the dog's superior olfactory capability relative to humans: "It's not even an instructor and a pupil [relationship]. Because if it was a true instructor and a pupil then we would know more about what they're doing and what they do. They have more knowledge than us of what they're doing."

Whilst I have illustrated that relations of collaborative engagement—that promote the capacity of bodies to affect each other—are at times desired in the training process, in other moments of training, a more detached mode of human–dog relating is necessitated in order to manage the effect of human influence, in keeping with good scientific practice.

iv. Monitoring and Managing Engagement in Human–Dog Relations

Mindful of the dog's propensity to look and be affected by their trainer's physiological cues, tools are employed by the trainers to momentarily deny dogs the possibility to 'look back' (Haraway 2008, 21). Particularly key in this regard is the screen inside the training room at MDD (Figure 5). Fitted with a tinted window, the screen allows the trainer to watch a dog search, whilst simultaneously preventing the dog from seeing his trainer's bodily cues, should he turn and attempt to look to his trainer. The screen is used during the more advanced stages of training (i.e., with dogs who are at a stage in which they know both the game and their target odour), and always when conducting formal testing trials. When the trainer stands behind the screen, the dog is prevented from being able to 'look back' and thus be affected by the physiological cues of his trainer; even, or indeed especially, those that are unconscious. One morning, during a training session, I asked Alexa about the use of the screen that Simon was standing behind and watching through, as Jess searched the stands. She explained, "They [the senior training staff] don't want Jess to rely on handler feedback. They want her to be confident enough on her own." Thus, implicit in the use of the screen is an assumption about the kinds of dogs they hope to emerge in the training process.

Figure 5. The author and Labrador Charlie stood behind the screen at MDD. The screen is composed of a tinted Perspex window that enables the trainer to watch the dog search, but precludes the dog from being able to see the trainer.

At PVWDC too, in the spaces where bio-detection training occurs, aspects of the materials and objects are also oriented towards managing the visibility of certain bodies. As referred to in the previous chapter, the room adjacent to the bio-detection training space serves as a viewing area fitted with a one-way tinted window. This window enables those spectating to see in but not to be seen by the dog working.[53] In addition, the video camera directed on the training space is linked up to the laptop belonging to Sebastian, the Postdoctoral Fellow, enabling him and others present to watch a dog work without their physical presence at the carousel.

In theorizing the use of such tools—the one-way screen, window, and the real-time video set-up—one might observe that their function, during a search, is to enable the constant observation of the dog whilst simultaneously precluding the dog from seeing his

[53] Of course, simply because a dog cannot *see* a human body watching through the window, is not to deny that the dog is likely aware that a human(s) is there. Dogs can smell and hear the people in the viewing room and often watch interns and volunteers go into this room before their training session formally begins.

trainer. With the capacity for visibility between the human and dog thus imbalanced, one might be tempted to apply Foucault's (1975) notion of the 'unequal gaze': the constant possibility of observation. This concept is grounded largely in Foucault's analysis of the design of the modern prison, known as the 'Panopticon', through which he explored the relationship between power and visibility. According to Foucault, it is the threat of constant surveillance that governs the body, as one can never be fully certain whether or not one is being watched.

However, applying Foucault's work to consider power relations beyond an exclusively human context is problematic due to the significant differences between the governance of human subjects and the monitoring and training of dogs in this case. Nevertheless, whilst Foucault himself never explicitly addressed human–animal relations, his ideas have been applied to consider how relations between humans and animals, particularly in an agricultural context, might be theorized as examples of disciplinary power (Thierman 2010), pastoral power (Cole 2011), or biopower (Holloway 2007). Beyond the spaces of farming, Kirk (2017) considers the challenge that is entailed in utilizing Foucault's concepts to think through the power relationships between humans and animals in the context of the laboratory. For Kirk, a fundamental question tied to the viability of employing a Foucaultian analysis to consider how animals are entangled within biopower in this context, is whether animals meet Foucault's twofold notion of 'subjects' (Foucault 1994): the products and processes of power, according to Foucault's understanding of power as relational and productive. Whilst, as Kirk (2017, 101) argues, animals satisfy Foucault's first sense of 'subject', as being 'subject to someone else by control or dependence' (Foucault 1994, 331), their capacity to act in Foucault's second sense of subject, being 'tied to his own identity by a conscience or self-knowledge', is less clear.

Certainly, it has been illustrated in studies of dog-cognition that dogs are sensitive to the attentional activity of humans and that this influences their own behaviour, suggesting a quality of awareness of self and other. For instance, dogs are four times more likely to disobey a human's instruction not to take food when a room is dark compared to when it is lit (Kaminski, Pitsch and Tomasello 2012). This suggests that they can understand something of the human's perspective. Other studies reveal the significance of human eyes as a signal influencing a dog's behaviour (Call, Bräueur, Kaminski and Tomasello 2003). However, whilst these studies suggest that dogs have some sensitivity to cues related to attention, it remains uncertain whether this constitutes a flexible

understanding of *seeing* rather than a hardwired behaviour or a learned response. Thus, although studies in dog-cognition demonstrate that dogs are sensitive to the attentional activity of humans and that this shapes their behaviour, I remain cautious with regards to the notion that dogs might internalize governance in the same way as Foucault describes of prisoners—aware that their actions could be being watched at any instant.

What the use of the screen and other tools undoubtedly does illustrate however, is a fundamental aspect of how dogs are perceived by the humans working with them: as responsive, intelligent beings who are highly capable of reading and, more significantly, being affected by human communicative cues. Notions of 'good' scientific data and how human influence, or affective encounters, might negatively affect this are also implicit in these practices. Therefore, that what dogs can see as they conduct their searches must be monitored and managed in order to produce 'good' bio-detection dogs, research subjects and scientific practice. As Matei Candea (2013) notes, it is commonplace among researchers to warn of the dangers of human influence in scientific practice. One of the classic stories recounted to illustrate the potential peril of human influence is that of 'Clever Hans', the horse who people believed could count, but who was in fact picking up on subtle physiological cues to the correct answer in the body of whoever was asking the question.

However, I note that among my informants, the concern regarding human influence runs deeper than a worry that the trainer might give the location of the target away through their bodily gestures; it also relates to their concern that dogs might pick up on and be affected by the emotional state of humans. Indeed, the risk of 'giving away the answer', as it were, is already explicitly acknowledged and mitigated by methods of training double-blind during more advanced stages of training (and always during testing phases), meaning that the trainers do not know which sample is which. Rather, the further matter of concern in this particular context is tied to an understanding of the deep human–dog bonds and affective relations that develop in these training relationships. Sam, a trainer at MDD, alerted me to this during a discussion about trainer-dog relationships, telling me that, "Science-y people want studies to be double-blind because your perception of the dog will change if they keep getting it wrong. You get disheartened if the dog is making lots of mistakes. Then the dog picks up on this." Thus, the screen arguably acts as a barrier to prevent human feelings and moods that might, albeit unintentionally, through their bodily comportment, affect the disposition of the dog and thus jeopardize his detection accuracy.

In short, to ensure the production of reliable detection dogs and robust scientific practice, the affective potential of human–dog encounters must be constantly monitored and managed.

By precluding the dog from reading human bodily cues during a search, the screen also helps to ensure that, as aforementioned in Alexa's explanation, the dog is making decisions about the samples independently, without being guided by communicative cues—intentional or otherwise—from their trainers. It is thus clear that the trainers do not only want bio-detection dogs to simply follow commands, but crucially to have the confidence to make their own decisions.

Whilst the visual technologies of the screen and one-way windows are an important element in the monitoring and management of affect at the interface of (human and canine) bodies, it is notable that human bodies are not only monitored and managed in relation to the visual, but also the auditory. As the trainers listen to the dogs—quite literally—so too do the dogs listen to the trainers. Because sounds are understood to communicate, among other things, emotional information that dogs are able to perceive (Albuquerque et al. 2016), human sounds—including, but not restricted to, spoken voice—in conjunction with body language, must be effectively managed by the trainers in their encounters with the dogs. In keeping with bodily movements, sounds can be considered either advantageous or detrimental to the dog's work, depending on the type of sound, the context of encounter, and the individual dog's temperament.

Sometimes, the sounds produced by trainers are expressed without intent. It is these sounds that tend to be the most concerning to trainers. For instance, during a training session with Rolo—a session in which Alexa, working nonblind, knew where the target was in the lineup—I watched Alexa, stood behind the screen, dip her hand into her pocket as she observed Rolo approaching the target sample. Her action caused a rustling sound. Rolo sat down immediately at the sample. Alexa clicked and rewarded him, but walking back to the screen, with Rolo by her side, she scowled her face in frustration and said to herself, "Stop putting your hand in your pocket Alexa!" To prevent premature fidgeting and the associated bodily and auditory cues, many trainers watch their dogs work with their hands crossed over behind their backs.

On other occasions, the unintended sounds trainers produce convey emotional information. For instance, during a warm-up run on the morning of a day of double-blind testing at MDD, Shadow failed to indicate a target sample, incorrectly giving the 'all-clear'

indication to his trainer Kelly by returning to her at the screen after searching. Managing the computer in the training room that day, it was my job to give Kelly the news that Shadow had given an incorrect answer. Kelly, who I knew was feeling nervous about the day, pursed her lips and huffed in visible and audible disappointment. A few moments later, Claire, who had been watching through the window from the adjacent office, opened the door to the training room and advised Kelly not to huff again if Shadow gives another incorrect answer. She explained that she had noticed Shadow 'drop'[54] when Kelly huffed. Looking at Shadow, I noticed his tail hanging low and stationary as he stood, unanimated, waiting for direction from Kelly.

However, rather than attempting to eliminate the influence of human voice from all moments of dog-training, on the contrary I regularly observed the trainers actively utilising their voice as a training tool to support canine learning. Sue, the Training Manager at PVWDC explained to me why she considers it essential to talk to dogs in training:

> "I like to talk when I dog train. If you watch really good dog-trainers, they all have dialogues with their dogs. They're not dead silent, they talk. And they have tones that they use and speeds that they say things and sounds, 'cause it makes it interesting."

The most common and routine example of the use of one's voice as a training tool is in praise commands. When a dog makes a correct decision during a search, either alerting at the target odour or giving an 'all clear' behaviour in response to a 'blank' run, praise is communicated from the trainer with phrases such as: 'Good boy!', 'Clever girly!', 'Yes!' and 'Great job!'. Both the pitch and volume of voice used to communicate these phrases are much higher than that of everyday conversation and notably closer to the communicative characteristics adults often use in interactions with children (Sanders and

[54] I heard this description, of a dog having 'dropped', on a number of occasions at MDD during training sessions and it also came up in interviews when discussing human–dog communication. The term, as it is used by these trainers, refers to a dog who is uncertain or lacking in confidence. Such an interpretation of the dog's inner state is thus believed to be visible in the minutiae of the dog's body language. When a dog is considered to have 'dropped', their body language tends to include a combination of a low tail carriage, low head, arched back and a lower hind end.

Arluke 1996). Studies in dog cognition support this emphasis on the human voice in communication with dogs, suggesting that both what we say and how we say it matters to dogs. For example, in a recent study conducted by ethologists in Hungary (Andics, et al. 2016), it was found that the reward pathway in the dog's brains lit up when they heard both praising words and an approving intonation, but not when they heard random words spoken in a praising tone or praise words spoken in a flat tone.

This discussion has illuminated the trainers' oscillation between practices of both attachment and detachment in their encounters with the dogs. To make sense of this, I draw on Candea's (2010) proposal to consider practices of attachment and detachment not as incompatibly opposing, but as interwoven practices. For Candea, based on ethnographic fieldwork focusing on meerkats and ethologists in the Kalahari Desert, detachment emerges as a specific mode of engagement: a cultivated distance that is not merely a case of standing back to observe animals. Candea details how the researchers balanced 'the pragmatic need to approach the animals' with 'distancing measures to minimize human interference in the animals' behaviour' (Ibid., 245). For instance, although meerkats were free to climb on to the shoulders of a researcher, researchers refrained from instigating any physical contact with the meerkats.

Among my informants, a temporary relation of detached observation is promoted through the implementation of a material separation (e.g., the screen at MDD) between the trainer and the dog. Thus, in the case of bio-detection dogs, it is an interspecies engagement that accommodates space for moments of both collaboration between human and dog, and at other times, relations of cultivated and manageable distance that promote successful training practices as well as good research participants, trainers-come-researchers and data. In emphasizing the partial connections *and* divisions that comprise the relationships between trainers and bio-detection dogs, these relationships might be understood with Joanna Latimer's (2013) notion of 'being alongside': a way of thinking about our dwelling with other kinds that 'emphasizes switches in ground, and expresses the limits and the partialness of any connection and of any sense of mutuality' (Latimer and Miele 2013, 16). Whilst some anthropologists, notably Ingold (2000: 13-16), have contrasted the detached "Western" scientific knowledge of animals to the engaged and relational knowledge of "non-Western" Others (Candea 2010, 250), for my informants it is a capacity to oscillate between both distant and relational modes of knowledge that enables the production of bio-detection dogs and the associated knowledge that is generated. On

one hand, a physical boundary (the screen) imposes a material and conceptual distance between the human and dog; reinforcing a separation between observer and observed, consistent with the ideals of 'objective' science, or modern knowledge practices that work to separate the social from the natural (Latour 1993). This distance is productively engaged with by the trainers in their attempts to create bio-detection dogs that embody independency in their working behaviour. However, the enforced separation is born out of a recognition that the dogs and trainers are entangled in mutually affective and intersubjective relations that are also essential to the performance of this human-dog detector team; the reliability of this dyad depends on the trainer's capacity to interpret an individual dog's behaviour. In effect, the pragmatic need to engage with the dogs during some aspects of training must be balanced by distancing techniques to prevent human interference in the dogs' behaviour.

The intertwinement of attachment and detachment that characterizes the shape of human–dog connectedness among my informants may be partly understood in relation to the dual perspective from which the trainers perceive the dogs. In addition to the role of dog-trainers, my human informants also adopt the responsibility of researchers: both in a formal sense as they collect data during each training session, and informally as they strive to make sense of the dog's behaviours. Like Smuts (2006), who in addition to baboons, studies social relationships between dogs—with Smuts' personal dogs participating in the research—many of the dog-trainers have close personal relationships with the dogs who they both train and observe in the pursuit of scientific knowledge. For instance, several of the trainers at both organisations have provided both temporary and long-term foster homes to some of the dogs with whom they also work. Smuts describes her job as putting her in 'the unusual position of experiencing [her] subjects in two very different ways: from the 'outside, objective' perspective of a scientist, and the 'inside, subjective' perspective of a human interacting daily with beloved companions' (Ibid., 116). This dual kind of perspective has been observed among researchers investigating dogs as many as seven decades ago, as Amy Nelson (2017) illuminates how researchers studying dogs involved in the Soviet space programme experienced a tension between their 'stance as a neutral scientist investigating natural material and his involved, even sentimental, attachment to experimental subjects' (92).

v. Conclusion

This chapter has argued that the recent shift in approaches towards dog-training, and the simultaneous change in how trainers conceive of the dog's position within the training relationship, has promoted an obligation among trainers to become attentive to the subjective experiences of their dogs. Such a duty on the part of trainers reflects their assumption of the dog as a sentient being rather than a generic black-box, in addition to the notion that the dog has a greater sensitivity to the odour of human disease than their human partners.

The recognition, shared by my trainer informants, that dogs both look and speak back to them has implications for training practices that have been illustrated in this chapter. In particular, I have argued that, through the intertwinement of practices of both attachment and detachment, the dogs can become good participants for the research aspect of this work, their trainers can become good researchers, and good data can be produced.

The next chapter takes the focus beyond the trainers' practices of merely listening to and acknowledging the specific experience of their dogs to consider how the trainers subsequently respond to the dogs, incorporating something of the dog's perspective into the training process.

Chapter 5. Care-Full Training and Research

Following on from the discussions presented in the previous chapter, which highlighted the trainers' active curiosity about the dogs' perspective and obligation to incorporate this into their modes of training and communication, this chapter explores how the trainers' understandings of the dogs' subjective experience shape their everyday encounters. Here, influenced by the work of Despret (2004) and Haraway (2008), I conceptualize the trainers' attentiveness to the dog's desires and needs as a practice of care. This chapter charts the particular shape of care as it is enacted in my field sites.

i. Locating Care in Scientific Practice

> Animal use and animal care are not separated but connected through capacities to recognize and respond to the suffering of another. (Davies et al. 2018)

In the pursuit of scientific knowledge, even where invasive and undoubtedly painful experiments on animals constitute the research process, scholars have observed that practices of care form an essential part of the researcher's labour (Friese 2013; Haraway 2008; Holmberg 2011; Pemberton 2004). As Haraway (2008, 70) states, 'Using a model organism in an experiment is a common necessity in research. The necessity and justifications, no matter how strong, do not obviate the obligations of care and sharing pain'. From an ethical standpoint, care practices can be considered actions that enable research subjects to 'speak back' (Giraud and Hollin 2006; Stengers 1997) and that oblige researchers to respond to the needs and demands of those being studied.

For example, exploring the role of care practices in the process of transforming a dog into a research subject for the study of haemophilia, Stephen Pemberton (2004) highlights how care and science go hand-in-hand when animals are used as model organisms in the laboratory. Pemberton argues that the production of 'good' canine research subjects in the laboratory requires that the humans first and foremost care for the animals. Specifically, Pemberton explores the 'creation' of an experimental organism, or technology, for studying a human disease and the origins of the canine hemophiliac as 'patient', beginning in the late 1940s in the United States. The study of these dogs directly contributed to the development of the first widely marketed pharmaceutical for hemophilia in humans, transforming it into a manageable disease. Significantly, however, the dogs did

not originate as ready-made models for the production of human medicine. Rather, Pemberton describes how the 'canine hemophiliac' was produced through—among other things—breeding and selection, and dog care practices. The biggest challenge the team of researchers faced was keeping the bleeder puppies alive. Therefore, before becoming models and technologies, the dogs had to become patients. Simultaneously, before functioning as researchers the laboratory staff had to function as caregivers:

> Significantly, then, scientists' manipulations of their subjects were preceded by a necessity to care. The hemophilic dogs were not only treated 'humanely' but also framed as patients in this setting. Or, to put this differently, the story of Brinkhous [the lead researcher] and his hemophilic dogs suggests that a moral imperative is operative in the passage between laboratory and clinic…this imperative means that we cannot understand how scientists discipline their experimental organisms without understanding how *these organisms also discipline scientists, forcing them to care.* (Ibid., 205, emphasis added)

Thus, Pemberton argues that the researchers cultivated a space in which dogs were conceptualized not only as technologies, but also as organisms with agency and care needs to which the researchers responded.

In the context of bio-detection training and research as it is conducted by my informants, the everyday practices of care are arguably less ostensibly remarkable than of those performed in the aforementioned laboratory-based work Pemberton (2004) considers, in which specialized care is necessary to keep an animal alive. However, despite their mundane appearance, I maintain that such acts are nevertheless fundamental in the training, or cultivation, of bio-detection dogs: the beings about (and *with*) whom scientific data is ultimately sought in this context.

At PVWDC, many of the mundane care practices towards the dogs—such as grooming and potty-walking—are completed by the center's voluntary workforce. Before being 'cleared' to conduct these practices on one's own, without the presence of a trainer or a more experienced volunteer, a volunteer is obliged to first watch and learn for many

hours. Keen to become authorized to groom, one morning I buddied up with intern Jason, to watch as he completed Labrador Kira's 'husbandry' routine.[55]

Jason is a twenty-one-year-old Psychology major student at a nearby university, completing a six-month internship at PVWDC as part of his degree's 'co-op' programme. I join him as he walks over to Kira's kennel. On the 'activity sheet' attached to a clipboard which is fastened on to the front of Kira's kennel, Jason makes some inscriptions in the box referring to today. Looking at the time on his phone, he notes the time, 10:04, the activity descriptor 'PE', shorthand for 'Physical Examination', and his initials, 'J.S.'.[56] *Then, he takes out a leash from the box fixed to the kennel door and turns his focus onto Kira who is stood up inside the kennel. The pair lock eyes and after a momentary stand-off, Kira moves herself into a seated position. Jason opens the kennel door, clips the leash onto Kira's collar, says "yes," and Kira responds by stepping out of the kennel. Before making their way into the room used for husbandry, Jason walks Kira outside the parameter of the building "to see if she needs to pee." Once inside the husbandry area—a former locker room within the center's facility that is a former gymnasium—Jason removes the leash from Kira's collar and kneels down on the floor next to her. The tiled floor of the room is partially covered with foam mats: non-slip, easy to clean and comfortable for human knees to rest on.*

Jason talks me through the session, telling me that husbandry is performed both to keep on top of the dog's grooming and to help desensitize the dogs to certain objects and situations that they might encounter during a real physical examination. Jason begins by taking a hairbrush from the 'husbandry box': a plastic box containing various items of equipment used for this practice. He holds the object in his hand and raises it in line with Kira's eyes, around one foot from her face. "I show the object first," he tells me. Kira

[55] 'Husbandry' is the term used at PVWDC that encapsulates grooming activities.

[56] At PVWDC, activity sheets are fixed to every dog's kennel and are used to keep track of the daily activities of each dog. Every time a dog is taken out of his kennel, the handler is required to make a note of the exact time a dog leaves and returns to his kennel, the handler's initials and the nature of the activity. Activities include: 'PW' for potty-walking; 'T' for training; and 'FT' for free time, which can include playing ball or socializing with other dogs; 'A' for agility, and; 'PE' for physical examination, which includes both veterinary checks and grooming practices. The data gathered from these sheets is analyzed and used to inform the center's knowledge about how each dog's time is spent when they are on site.

appears unfazed by the object and Jason slowly moves the brush towards her, gently touching it against her side. "Good girl," he assures. He brushes her side and she continues to remain still, gazing into his eyes. "Yes!" Jason exclaims, offering her a kibble treat from a pouch attached to his waist belt. "The slower you take it, the more likely you are to get a positive result," he explains, adding, "This can take as long as you want it to."

After a few minutes of brushing, Jason moves the focus on to Kira's nails. Whilst the interns are not permitted to perform the actual practice of nail clipping, the husbandry routine includes desensitizing the dog to the clippers used for this. Jason asks Kira to sit, which she does. Concerning the dog's bodily position during this practice, Jason explains, "It's easiest to do from a sit or a down, whatever's more comfortable for the dog." "Paw," Jason says, before he touches one of Kira's front feet, resting his hand on her foot for a few seconds. Kira remains sat and tolerates Jason's touch. Before removing his hand, he says "yes" and rewards her with a piece of kibble. He repeats the exercise on the other front foot. He then returns to the first foot, this time gently stroking his fingers on the areas in between the nails, commenting, "You want the duration to be longer and longer each time." He takes a set of black nail clippers from the box and places them against Kira's foot. She moves away from him by a few inches. He reassures her by putting the clippers aside and adjusts his position on the floor. She returns to a seated position next to him, but moves away again when the clippers are re-presented. Jason asks me if I can pass him the orange clippers instead because, he muses, "she might be more familiar with those." These prove a little more successful as Kira permits Jason to present the clippers at her feet for a moment or two, before he treats her. He ends the attention on her nails shortly after, explaining, "I don't want to push her if she isn't comfortable."

Next, Jason moves on to focus on Kira's teeth. Whilst retrieving the toothpaste from the box, Kira has moved to the other side of the room, sniffing the gaps around a doorframe, the other side of which contains the center's dog food store. "Come here sweetie," he says. With Kira in front of him, he says "muzzle," and then cups his right hand over her snout, holding it for a few seconds before releasing and treating her. Next, he says "teeth," and gently pulls up her lip on one side, followed by a treat. After repeating on the other side, he tells me, "you can work in with the toothbrush gradually." He does not use the toothbrush today. Instead, he puts some dog-safe toothpaste (vanilla mint flavor) on his finger. Kira moves away when Jason presents his finger to her mouth. After

getting the same response twice, he instead holds his finger down and away from her mouth and allows her to simply lick the paste from his finger.

He wipes his finger on his jeans and moves on to Kira's ears. "Sit. Ears." With Kira sat in front of him, Jason gently lifts and strokes each ear in turn. "That's an easy one," he smiles and feeds Kira some kibble.

Finally, Jason focuses on Kira's eyes. He says "eyes," before using his fingers to apply gentle pressure to the area beneath each eye and looks directly into her eyes. Their mutual gaze is interrupted however, as we hear barking from the kennel area that is situated on the other side of this room. Kira is looking towards the door and Jason comments, "I wish this room was more soundproof."

In the grooming encounter between Jason and Kira, we are able to observe the simultaneous disciplining of two bodies. As Jason attempts to shape Kira into a particular being—one who is tolerant of human touch and corporeal investigation—Kira forces Jason to become attentive to her preferences and aversions. Here, we can apply Greenhough and Roe's (2011) illustration of the association between attention to somatic sensibilities and the development of more care-full practices of animal caretakers in the context of animal experimentation. Rendering himself available to Kira's desires and enabling the dog to 'speak back' regarding her situation, this example highlights how care is fundamentally entangled with the question of canine agency.

While this discussion has focused on an instance of care practices *outside* the bio-detection training room, below I focus an assessment of the character of care within the more formal spaces of training and scientific practice.

ii. Tinkering

In addition to the more obvious practices of care such as grooming, acts of care can also be observed during the training sessions, specifically in the relation between a trainer, dog and the training equipment. To illustrate this, I draw on the concept of 'tinkering' as it has been extended beyond the realm of scientific practice and into discussions focused on the character of care in clinics and other healthcare settings by Mol and colleagues (2010). For these scholars, tinkering offers a novel way of thinking about the character of care, particularly in medical contexts, as a process of dynamic arrangement through which novel possibilities, identities, and emotions emerge for both the caregiver and the cared-for. In

clinics and other settings, tinkering involves making small adjustments to equipment, pharmaceuticals, spatial arrangements and modes of monitoring and documenting (Manderson, Cartwright, and Hardon 2016, 175). According to Myriam Winance (2006; 2010), whose work explores how wheelchairs are adapted to their users, caring is not simply a case of giving something to others who may then passively receive it. Rather, to care is to carefully consider, test, feel, adapt, acknowledge details and make adjustments, until an appropriate arrangement (material, emotional and relational) is realized. In the process, Winance argues that it is not just the wheelchair that is adapted, but also the multiple people involved in its use.

By drawing on Winance's analysis of the tinkering character of care with regards to the adaptation of wheelchairs to their users, and extending it out of this clinical context, I note that the tinkering of care can be illustrated in the distinct spaces of the detection-dog training rooms. Here, in everyday training sessions, the training apparatus is routinely adjusted to meet the needs of an individual dog. For instance, at MDD, before a dog is tasked to search, the height of the stands or carousel arms are adjusted by his trainer or another person helping, so that the dog's nose may meet the odour sample with ease. As the dog searches, his trainer, watching how the dog's body is moving, might infer that he is having difficulty rigorously investigating the odour due to the height or angle of the stands. Between runs, in response to the dog's performance, the angle and height might then be further tinkered with by the trainer or an assistant. The angle and position of the screen is sometimes adjusted too. For instance, whenever a dog 'skipped' (i.e., failed to search) the first position, I often observed trainers move the position of the screen back slightly, trying to ensure that the first position is visible to the dog and less avoidable as he approaches the stands or carousel. The adjustability of the screen and stands—the screen featuring wheels, and the stands with pins and holes—enables tinkering practices to be incorporated into the character of training with ease. In short, the trainer's 'toolkit' is designed to be tinkered with.

The routine practices of tinkering that take place in training sessions highlight the dynamic shape of care practices as they are performed when working with dogs. Continuously reading the dogs' bodies, the trainers acquire a tacit knowledge about the behaviour of dogs, both generally and individually, that guides their actions. Moreover, the tinkering of samples and equipment highlights the processual shape of learning that these trainers undergo as they become increasingly skilled and capable. Knowing how to respond in the moment of a given training session is an embodied kind of knowledge

acquired through practice and personal experience, rather than a knowledge that is given or can be readily taught outside the embodied encounter between trainer and dog. The significance of this tacit knowledge among the trainers was made clear in a comment made by Simon to Neil, regarding the performance of a dog: "*You'll know when you see her…It's easier for me to show you than tell you. I can't explain it.*"

As well as the everyday tinkering of adjustable equipment, there is also a commitment towards developing the design of the equipment itself so that it is better-suited to the bodies of the dogs. For example, one afternoon at MDD, the bio-detection department welcomed a group of designers into the training room. With them, the design team had brought in some equipment prototypes, including a cone-shaped attachment for the sample arms and a stand with greater scope for adjustability. These prototypes had been designed based on information offered from the trainers about how the dogs search. To get a better sense of this, the designers had also visited previously, watched the dogs work and discussed with the trainers what kind of issues they felt the equipment caused them. Central to the creation of the cone-shaped design is a recognition of the dog's olfactory system and, in particular, the long nose characteristic of this animal.[57] The hope invested in the design is centered around the notion that if a dog inserts his snout into the cone he ought to be able to inhale a more concentrated sample of the odour, helping him to increase his chance of accurately assessing the odour. Within ten minutes of the design team arriving, Simon suggested that they try out the new cone attachment with some of the dogs to see how they respond. At the back of the room, I stood and watched alongside the trainers and designers.

After working well in his morning training session, Kelly brings Labrador Leo in the room to try the cone attachment. Meanwhile, Ed had attached the cones onto the sample arms of the first two stands in a lineup of four. The positive sample—in this case, an artificial training odour—was then placed in position two by Ed. Leo walked along the stands with a slower pace than I had seen him search during his earlier training session and he did not put his nose into the cone of either position one or two. Simon comments, "It's so interesting to see the change in dynamic," before pointing out that one of his

[57] While brachycephalic dogs (dogs with short noses and flat faces), such as Pugs and Chihuahuas are increasingly popular as pets, the olfactory system of these dogs is compromised (i.e., they have fewer olfactory receptor cells). No brachycephalic dogs are enrolled at MDD or PVWDC.

concerns about the cone was whether all the dogs will be able to fit their noses into it: "the spaniel can get his nose in it, but with his [pointing to Leo] fat muzzle I wonder if he can get it in there." Leo is tasked to search the stands again and whilst he appears to scan over the cones, Kelly insists "he didn't put his nose in." "Come on then," she says, as Leo turns to walk back towards her. However, on his way back towards Kelly who is by now stood at the screen, he moves towards stand two and puts his nose into the cone, nudging at it whilst stood still, as is customary for his trained alert. Kelly clicks and, in unison, both her and Simon call out "good boy!"

Each dog responded in a slightly different way: some showed hesitation about the novel piece of equipment, standing back from it and turning to their trainer, while others displayed more curiosity, investigating the cone with interest. The cones obliged the dogs to behave in new ways; closing their mouths shut as they sniffed. At the same time, if the cones were to become fully operational the trainers would be impelled to learn slightly new ways of reading the dogs' search behaviour, given that the cone would conceal the dog's nose and mouth. In this instance, we can see how the dog's species-specific perspective and physiology is incorporated into designs through a process of tinkering that can be considered, following Winance (2006; 2010), a case of caring.

Thus, the relationships between the researchers, animals, and equipment I have detailed are distinct from sites of traditional scientific practices with animals, such as the laboratory, whereby it has been observed that the 'work must be fitted into the demands of the technology' (Birke 2007 [1994], 329). In Birke's research, for instance, one animal technician revealed that she had been required to dispose of all rats that did not meet a certain size criteria (inevitably including almost all the females), as only those rats (predominantly males) exceeding a certain size would fit the apparatus used to keep the head still during the experimental surgery. Such a practice is at considerable odds with the shape of interaction between the equipment and animals in these sites of detection-dog-training and research, where, on the contrary, the equipment is designed to suit the demands of the dogs and is adaptable to the physiology of the individual animals. Here, through the tinkering practices of care and the establishment of a human–dog dialogue that enables the trainer-come-researcher to develop a more nuanced understanding of a dog's perspective and needs, space is simultaneously created for the dogs to inform the shape of their environment and the direction of their work.

iii. Enabling Individuality

The precise character of care towards individual animals and the potential for the enactment or preclusion of care in a given context varies and is dependent, in part, on the particular sets of working practices and conditions that comprise each setting. More specifically, diverse cultures, technologies, economies and rationalities across different spaces of animal care impact the particular approaches towards the treatment of animals (Greenhough and Roe 2018).

Exploring the spaces and discourses that comprise the American slaughterhouse, the critical animal studies scholar, Stephen Thierman (2010), argues that care and concern (for both the humans and animals) are virtually unable to develop in this environment that is characterized by practices that ontologically reduce the individual. Describing how the individuality of pigs is reduced in the slaughterhouse, Thierman notes:

> Their reduction—begun in the various locations where they have been reared to slaughter weight—continues with the killing of the individual pigs when they enter this establishment. They become 'shoulders' that are segmented into different 'cuts' as they travel down the line and are packaged for distribution. To echo Linda Birke (2003), whom Acampora (2006) quotes, I would say that in the production of meat at the slaughterhouse, the living, breathing animals who ate, slept and interacted—often in atrocious conditions—literally disappear. In the slaughterhouse, their individuality is completely elided as they become inert commodities for human consumption. (Ibid., 107)

In explaining the absence of care in the slaughterhouse, Thierman draws attention to the various material and immaterial elements that structure this particular environment, including: its architectural form, laws, philosophical propositions and scientific theories. Taken together, he argues that these aspects comprise the particular 'apparatus of animality', or environment, of the slaughterhouse.[58] With these aspects recognized, it then becomes possible to ask questions about the kinds of relations between these elements, such as: 'What types of understandings of other animals are promoted at particular junctions; how are particular animals treated in specific locations; and, how are human actors invited/forced to act in various situations?' (Ibid., 93).

[58] Thierman invokes Foucault's (1978) notion of the 'apparatus of sexuality'.

To understand the presence and particular shape of care practices among my informants, following Thierman, we can attend to the relations between the various elements that comprise my field sites. Already, in the previous chapter, I have outlined one significant aspect of the 'apparatus of animality' operating in my field sites: the specific pedagogical approach to dog-training employed by my informants. Another element that structures care practices in these spaces are the adjustable pieces of training equipment, detailed in the above section. Now, I turn to briefly consider how the spatial organisation of the facilities, combined with the bio-detection research methodology, emerges as highly significant for the particular shape of care within these environments, whereby canine individuality—and a perception of the dog as a subject rather than a passive object—is maintained by the trainers.

The trainers work within the training spaces with individual dogs for around an hour each day, between three and five days per week. At MDD, when they are not formally working, the dogs dwell in the office space alongside their trainers—sleeping on dog beds scattered throughout the office they share, or underneath desks. This spatial organisation, mandated by the charity's 'no-kennel' policy, promotes the development of interspecies relationships that extend beyond the boundaries of the formalized work practices of both species. The frequent, mundane encounters—negotiating access to a chair for instance—offers the trainers and dogs the potential to acquire tacit knowledge about the needs of the other. Here, somatic sensibilities between the species are amplified and consequentially, the trainers develop an understanding of the dogs in which these animals are more than merely 'the right tool for the job' (Clarke and Fujimura 1992). As Kelly, a trainer at MDD, explained, "We have more of a relationship with them than that [than if they were purely tools]. If we didn't interact with them in any way other than to work with them they might be perceived of as tools. But they're around [the office]."

By contrast, due to the architectural design and research protocol of a conventional laboratory, significant numbers of animals in these settings are typically housed in large spaces, often totally separate from the researchers and only coming into contact with the researcher in the moments of experimentation (Birke 2012). Before moving into dog-training, Kelly had herself previously worked with laboratory animals and, during a conversation with me, she made an association between the shape of everyday human–animal interactions—tied to an organisation's spatial structure and the material quantity of the animals—and the kind of human–animal relationships that are rendered possible or

hindered. In particular, Kelly reflects on how she has experienced her own relationships with animals as differing depending on the quantity of animals under her care. Speaking about working in a laboratory, Kelly explains:

> "You don't have an interaction like you do [with the dogs here], you don't build a bond with those animals. There's too many. You're not handling like you are everyday here. Like, there's potentially a million mice in our facility at any one time…There is no relationship with those mice…you don't bond with them."

Simon added, "That can come down to time constraints." Nodding her head in agreement, Kelly replied, "Exactly. And I think if you only had ten mice to deal with every day for a week you'd probably build individual relationships."

Among bio-detection dogs, there is less standardization in comparison with the highly standardized model organisms Kelly worked with in her previous role. While the trainers are able to build individual bonds with the dogs whom they dwell and work alongside in their professional lives, the standardization of laboratory animals is arguably a significant factor in explaining why, '[a]t least to the untrained eye, one white rat looks much like another. They therefore lose individuality' (Birke (2007 [1994]), 331).[59] Drawing on the work of Ralph Acampora (2006), Thierman (2010) also associates standardization with the reduction of the animal's individuality, suggesting that laboratories have 'emptying effects' (Ibid., 106) that downgrade the animal's body from a 'somatic' or living body to one that is merely 'corporeal' (Acampora 2006, 99).

On the contrary, the spatial organisation and research protocol of the detection-dog workplace—that promote repeat, routine encounters between humans and dogs—helps

[59] However, it must certainly be acknowledged that emotional relationships can and do develop between researchers and laboratory animals. This is observed even where the animal's sacrifice is an inevitable component of the work. For instance, Simone Dennis (2013) reports how Brenda, one of Dennis' neuroscientist informants, expressed feelings of loss when the six rats with whom she interacted with on a daily basis were terminated. She associates Brenda's grief with the relations that were established between the scientist and rats through their daily interactions: interactions that demanded human–animal negotiation, intersubjectivity and established a kind of kinship between the species. However, having only six rats to oversee in this instance arguably helped to facilitate such attentive relationships between Brenda and the rats.

enable trainer-come-researchers to develop relationships and understandings of the experiences of individual animals. Certainly, working with dogs who are learning to respond in particular ways to specific odours requires one-on-one interactions and empathetic engagement with the experiences and perspectives of the animal other.

Furthermore, an acknowledgment of animal individuality is apparent even before dogs enter these spaces of scientific practice, as illustrated in the selection of dogs for this work. Dogs of various shapes and sizes are enrolled in the respective training programmes of both MDD and PVWDC. This is not without restrictions however, as the dogs are not greatly varied in terms of breeds. Bar a few exceptions, at MDD, the dogs are predominantly varieties of Labradors, Retrievers and Spaniels, and at PVWDC the majority of the dogs are either Labrador, Retriever or Shepherd types. Multiple factors drive the selection of these certain breeds including the working history of particular breeds, as well as public perceptions towards certain breeds. More specifically with regards to individual dogs, factors in dog-selection include: the working history of the dog's ancestors; the requirement that dogs are manageable for foster families; and the need for dogs to be content in the presence of other dogs at 'work', especially at MDD where dogs are not kennelled. However, compared to the iconic animals of scientific research—specifically, laboratory rodents—the variety in appearances among these canine cohorts is vast and standardization, in terms of size and physiology, is of far less concern.

In sum, I have suggested that an understanding of the dogs as individuals, further supported by the co-habiting spatial arrangement of human and dog and their frequent interaction, promotes practices of care shown towards the dogs.

iv. The Possibility for Resistance

As beings who are afforded the capacity to shape the very practices through which they are constituted, bio-detection dogs are also observed as being able to resist their enrolment and treatment in the training and research process. For instance, at MDD, only those dogs who are perceived as 'wanting' to take part in the work required are recruited to join the bio-detection department. While most dogs that come through the department's doors appear keen to engage in the scent-detection tasks, occasionally, dogs do not demonstrate an obvious desire to participate.

During my time in the field this happened once, with a small Cocker Spaniel who

spent much of his—fleeting—time in the training room either sat or lying down, seemingly uninterested in playing scent games. Although his tail wagged and he did not appear to be particularly uncomfortable in the environment, he was seemingly apathetic towards the pot containing a training odour, cupped by Ed's hand. Despite Ed's best efforts to engage the dog in the pot—tapping it with his fingers, moving his own nose towards it, and adjusting the position of his body—the dog remained disinclined. After a few more sessions without any change in the dog's behaviour towards the pot game, the decision was made that this dog was simply unsuited to this kind of work and a permanent home was found for him to live as a pet. Through the trainers' attentiveness to the dog's bodily comportment, the dogs are thus enabled to say 'no'.

Furthermore, once a dog is enrolled in the training programme, his willingness to participate is not taken for granted but is instead continuously monitored and responded to. Through the detailed reading and interpretation of canine bodies, trainers assess whether a dog's current mental state deems them suitable for the task at hand. The dog must be calm enough to search with focus, yet motivated enough to want to actively participate. The following example illustrates how a trainer considered a particular dog, not to be balanced enough to work during a training session.

Stood in the corner of the room by the computer desk, I watch on as Rolo searches the positions on the carousel at a very fast pace. He moves with such speed around the carousel that he fails to search several of the samples; 'skipping positions' as Simon, his trainer, puts it. In addition, he is being highly vocal between runs, panting with his mouth agape and occasionally barking too. According to Simon, Rolo is making a much greater amount of noise compared to usual. After only three runs (dogs usually work between fifteen and thirty runs per session), Simon elects to terminate the session, commenting, "I've never seen him this crazy. I want to leave him there, I don't want to try a blank with him. I think he'll miss [position] eight."

Working with individual dogs over repeat encounters, trainers like Simon build up knowledge about a particular dog's usual demeanor and know the 'mood'—inferred from nonverbal gestures—in which a dog performs best (i.e., with the greatest accuracy). By incorporating a sense of the animal's emotional state, the trainers can thus choose the most appropriate moments to conduct or cease work.

Relating the emotional states of animals to the question of animal agency in the scientific process, Michael Lynch (1988) details how he observed a researcher obtain compliance from his ant subjects. In the behavioural studies Lynch refers to, of ants that were required to navigate mazes, he describes how the researcher 'learned to interpret whether or not his subjects were agitated or 'calm' enough to undergo maze tests by examining the position and movements of their antennae' (Ibid., 280). Notably, Lynch describes this ability to attend to the animal's bodily sensibilities as something that must be *learned* by the researcher, rather than an innate capacity. For the trainers interacting with dogs, although many express an instinctive ability to communicate with dogs, developing an understanding of the 'normal' somatic sensibilities for an individual dog and how to respond appropriately to a dog's behaviour is a learned skill.

While dogs are the focus of this thesis, Lynch's work reminds us that the capacity for animal agency is not limited to dogs. Rather, it can be argued that a whole variety of animals—or nonhumans more broadly (e.g., the atoms or cells explored in Stengers' (1997) work)—are capable of exercising agency in research settings, provided that the conditions and care practices that underpin the work afford sufficient space for the nonhuman to 'speak back' and simultaneously enable the researcher to pay attention to these nonverbal cues and respond to them.

The mode through which I have demonstrated that dogs become research participants in detection studies—as individuals with agency—resembles the methods used by Berns and colleagues (2012; Berns and Cook 2016) in training dogs to 'cooperatively participate' (Ibid.) in fMRI studies without restraint or sedation. The team used training techniques of positive reinforcement to shape an extended 'down-stay' (i.e., the dog lying still on his front) and to train the dogs to wear earplugs to protect their ears. Significantly, Berns and his team employed an ethical protocol for dogs as research participants that is usually reserved for human subjects, giving them the opportunity to withdraw their participation should they wish. As a consequence, Berns and Cook (Ibid., 364) note that, of the animals used in their study, 'dogs can be treated as voluntary participants. Because they are unrestrained, if a dog does not want to be in the MRI scanner, she can simply leave'.

It is possible to consider the methodology employed by Berns and Cook (Ibid.) as well as that of my informants, as one in which a kind of nonverbal consent from the dog is attained somatically. The negotiation of consent here is associated with the dog's capacity to resist, or refuse, to participate in the study by having the ability to remove his

body from the situation. In their comparison of ethical guidelines and practices between scientific researchers and their subjects (human and animal alike) Greenhough and Roe (2011) focus on the ability of an individual to somatically respond to an experimental environment. Although their discussion refers specifically to animals enrolled in experimental research, thus differing in significant ways from the practices of research that bio-detection dogs participate in, their arguments remain useful for this analysis. Greenhough and Roe argue that in order to reconsider the ethics of experimental research (with either human or animal research subjects), the focus ought to move away from the *differences* between human and animal subjects (i.e., an emphasis on verbal consent), and move instead towards acknowledging what human and animal subjects *share*. What is shared, they note, is a 'capacity to respond, in nonverbal ways, to both the experimental process and the wider laboratory environment' (Ibid., 57). When restraint and sedation are absent, both human and animal subjects can, with their bodies, either join in with the experiment or task, or refuse to participate. Thereby, the authors extend the capacity to consent, 'or at least to refuse participation' (58) to animal subjects.

I follow both Berns (2012) and Greenhough and Roe (2011) in suggesting that the dogs in my field sites participate in a process of ongoing assent or dissent that is communicated somatically and attended to in the affective encounters between human and dog. Consequentially, I argue that the relationships between human and dog here are reciprocally shaped, as are the conditions of the dog's participation.

While there is, undoubtedly, ethical value in accommodating space for the animal to respond or resist in scientific practices, the way animals are treated, or cared for, has epistemological value too. The notion that the emotional experiences of animals influences the data of scientific study has been widely recognized by scientists since the late nineteenth century, with Otniel Dror (1999, 205) noting that in order to prevent the contamination of their results, Anglo-American physiologists set about 'recording, reporting, managing, and controlling the emotions of laboratory animals during physiological encounters'. As a result, it has been argued, 'the practice of knowing' becomes 'a practice of caring' (Despret 2004, 130).

As Carrie Friese (2013) notes, among her scientist informants working with model animals, 'poor care for animals is believed to result in inadequate scientific findings' (129). The promotion of caring encounters, on the other hand, is said to facilitate 'more responsive relationships between researchers and research-subjects…making it difficult to

manipulate subjects into merely conforming with pre-established assumptions (Stengers 1997; 2010; 2011)' (Giraud and Hollin 2016, 2). From this perspective, care has been considered as facilitating research subjects to 'speak back': the practice that, for philosopher Isabelle Stengers (1997), distinguishes 'good' from 'bad' science. According to Stengers, if the object under study is prevented from 'speaking back', scientific practice is threatened because 'the research has been done with the ulterior motive of imposing an answer on it' (McClintock in Stengers 1997, 126).

Whereas Stengers focuses on what it means for research objects like atoms or cells to 'speak back', Candea (2013) points out that animals (including humans) 'are more easily affected by "obligations" (rules and constraints imposed by experimenters) and may find it harder to impose their own "requirements" on the scientist' (109). Thus, when studying animals, it can be harder to afford the space Stengers insists is necessary to 'ensure that the object has been given every chance to "object" to the theories and assumptions of the scientists' (Candea 2013, 109). In such circumstances, care is depicted as especially imperative, given that practices of care foster a richer understanding of the needs of one's research subjects and enable researchers to respond appropriately (Davies 2012; Greenhough and Roe 2011).

In addition to the epistemological value of care, from this critical standpoint we can also consider care's productive value. Such reflection is required, given that my informants often made explicit an association between their care for the dog's subjective experience and the issue of productivity. For example, the notion that 'happy dogs work harder' was often professed by trainers at both organisations.[60] While highlighting the productive value of care, I do not propose that the trainers do not, simultaneously, have altruistic concerns for the welfare and wellbeing of the dogs. Although the dogs' labour is arguably commodified by the humans who task them to work in the processes of training and testing, these animals are not reduced to mere commodities for human exploitation. Rather, we can observe how care is often ambivalent in practice.

To help illustrate this argument, I draw on Eva Giraud and Gregory Hollin's (2016) analysis of the ambivalent role of care within the first large-scale experimental beagle colony at the University of California, Davis, which took place between 1951 and 1986.

[60] Within the scientific literature on animal behaviour, there are proven links between dog welfare and working ability. See Rooney et al. 2005; 2007; 2008.

Of this research process, the authors argue that although care practices shown towards the dogs permeated the experiments, with space for the dogs to 'object' and reshape the environment, 'care was ultimately utilized to meet predetermined experimental goals' (Ibid., 7). Thus, rather than simply attending to the affective qualities of the dogs, they argue that the researchers placated the objections and desires of the dogs 'so that they could not threaten experimental goals' (Ibid., 10). In short, the researchers were 'learning from them in order to *actively manipulate* these qualities, moulding the animals into "experimental dogs"' (Ibid., 13).

Certainly, in attending to the needs and desires of the dogs, my informants seek to incorporate the knowledge they acquire about the dogs—both at the level of the species and the individual—into their practices; subsequently shaping and promoting the emergence of particular kinds of dogs (i.e., reliable detection dogs and good research subjects), people (i.e., response-able trainers-come-researchers) and data.

v. Conclusion

Following an understanding of care as a methodological means of paying attention to the feelings and needs of another, this chapter has detailed how accommodating space for the dogs to respond or resist in training practices can promote more care-full training and research practices. The insights developed here arguably reflect the increasingly significant role of 'cultures of care' in animal research (Davies et al. 2018), where the cultivation of a good culture of care is argued to be an ongoing, relational process between the caretaker and the cared for (Greenhough and Roe 2018).

This discussion has engaged with the ethical, epistemological and productive values of accommodating care practices into bio-detection dog-training and research, revealing that even mundane practices of care are entangled with questions of nonhuman agency. The capacity of the dogs to express their agency, as beings who can speak back, has been demonstrated to be enabled with practices and material equipment that are amenable to tinkering in relation to the individual dog, and through the formation of relations between trainer-come-researcher and bio-detection dog whereby the trainer 'risks being touched/affected by what matters for the animal he/she observes' (Despret 2013, 57). These relationships are further supported by a research protocol that promotes the frequent encounter of individual humans and dogs. Therefore, rather than passive black-boxes or animals merely instrumentally moulded into pre-determined and fixed

experimental objects, I have argued that the particular approaches and methods of training adopted by my human informants enable the dogs themselves to jointly constitute the material reality of everyday activities.

In the following chapter I will consider how the agency of the dogs shapes not only the course of events within a single training session, but how this might be understood to be involved in the shaping of the dogs' labour more broadly, conceptualized in terms of 'careers'. Notions of care will remain implicit as I turn to consider how attempts to incorporate the dog's perspective and desires into decisions about their daily occupation supports the dogs to flourish as individuals.

Chapter 6. Careers, Flourishing and Interspecies Responsibility

In this chapter, I unpack the terminology used by the organisations to frame the dog's relationships with their labour. First, I consider the notion shared among my informants, that the dogs have an element of choice, both in their everyday training activities and in selecting their career specialty. Understood as 'co-workers', I assess how personhood is projected onto them. Then, I illustrate and reflect on the trainers' shared desire to offer the dogs meaningful lives and support them to reach their potential.

i. A Dog's Choice?

In this section, the dog's agency—both as it is constructed and represented by the humans, and how it is observed to be displayed by the dogs themselves—is explored further, through an analysis of my informants' framing of the dog's work in terminology that emphasizes 'choice'. The emphasis on choice here, as an indicator of agency, reflects the assertion by Sarah McFarland and Ryan Hediger (2009, 18) that 'choice is part of what defines agency' among animals.

The conceptualization of these dogs as beings for whom choices are available is fundamentally tied to ideas about the consequences of the training methods used. For instance, reflecting on how she perceives the dog's subjectivity as differing, depending on whether their training is based on traditional force-based methods or contemporary methods of positive reinforcement, Jen stressed:

> "There's a completely different component to the way dogs work with force versus positive reinforcement, because you have a dog that's motivated here [at PVWDC] with positive reinforcement. There's food, there's toys, there's tugs, there's tactile touch. Whatever motivates the dog, that's what we utilise to train them. Whereas, with this other method [of force and punishment, imposed by her previous employer], there really was no reward for the dog to work. So, the dog's demeanour, their performance and their body language was a lot different for sure. They just weren't happy working dogs. They worked because they *had* to, in my opinion."

According to Jen, when methods of force characterize training, dogs work because they *have* to. However, when force is absent, the conditions of the relationship are altered and dogs do not 'have' to work in the same way in which they do under physical restraint (or the threat of). Instead, working becomes more of a 'choice' on the part of the dog, who, if he partakes in this work elects to not because of a threat of punishment should he not cooperate, but because he wants to gain the reward: a particular food or toy that is considered desirable to the dog.

Taking this position a step further, Edminster (2011b, 41) notes that the staff, volunteers, and clients working with assistance dogs in the United States not only assert that the dogs *want* to do this work, but in addition 'they *have to* want to do this work…independent motivation, action, and desire on the part of the dogs are absolutely essential'. Certainly, where human force is omitted from any kind of animal training, in order to succeed the willing cooperation of the animal is necessary. However, the specific, often life-saving labour that assistance dogs are tasked with, places significant emphasis on the will of the dog to perform his duties. For instance, the assistance dogs trained by the organisation Edminster worked with are trained to assist individuals with a range of health issues, from diabetes to hearing-loss, that make the client highly vulnerable to navigating everyday life and mean that their health and safety is dependent on the independent desire of their dogs to consistently and repeatedly perform their trained duties.

As aforementioned in chapter 3, the labour of bio-detection dogs is distinct from that of assistance dogs in important ways: a recognition that helps us to account for the particular understanding of choice in Edminster's context. However, consistent with the desired disposition of an assistance dog as described by Edminster's informants, my trainer interlocutors too can be understood as seeking to enroll and work with dogs who are characterized by 'independent motivation, action, and desire' (Ibid.) to work. At MDD, the dogs' 'independent desire' to work is routinely said to be illustrated by the often-present gaggle of dogs sat at the door of the training room, watching through the window that runs down the length of the door while another dog is in a training session. Whenever a trainer opens the door to let a dog in for training, others often attempt to sneak in.

However, whilst independent motivation, action, and desire are considered important attributes of bio-detection dogs, their labour must be understood as predicated on a relationship of interdependence between the dog and his trainer. While working independently on their respective species-specific tasks—the dog sniffing and responding to odours, and the human interpreting the dog's behaviour and providing him with

feedback—their work is a mutually constituted practice in which the pair can also be understood to work in tandem. Thus, whilst the dogs can be considered agents, their actions are fundamentally entangled with those of their human training partners, and vice versa, demanding an ethnographic engagement with both partners in order to acquire an understanding of how the dogs exercise their agency in practice.

The previous chapter detailed how, through an attentiveness to the dog's body, trainers attempt to acquire what we might call the dog's 'active cooperation' (Haraway 2008, 55): a sensibility that is subject to ongoing renegotiation in their repeat encounters. What I want to highlight in this section however, is that when dogs are considered to be willing participants, trainers consider it their responsibility to respond to the dog in a manner that supports the dog's ability to achieve his potential. To do so, they offer the dog motivation that they consider appropriate—to both the dog as a species and to the particular dog as an individual.

Speaking to a group of visiting high school students on a morning tour of PVWDC, Sue explained why she considers the practice of motivating dogs to be so essential to her role as a trainer; likening the necessity of instilling motivation in dogs to the students' own motivation to attend school and their teacher's motivation to do their job:

> "If I took away your grades and said, 'Just study and you know, good luck getting into college,' would you wanna keep studying? Or if I said, 'Hey you're gonna earn grades, you're gonna earn college, you're gonna earn scholarship money,' then you have a reason to study. Or, just because learning is a great thing to do. But if I take away teacher's pay checks and say, 'Keep coming to work,' their motivation drops. So if we don't motivate dogs, they're just like us. What motivates them to do something? Value in rewards is really important, just like if I give you a really hard job and only pay you a dollar. Or it's a really hard job and I'm gonna pay you one hundred dollars, you're gonna be more motivated to do that job. So there's value in treats too. Kibble, like the regular dog food that they get every day is kind of low. And then maybe for each dog it's different, maybe a dog loves cheese or chicken."

As Sue notes, the reward that motivates one dog to want to work is not necessarily the same for another dog. Therefore, a further associated element of the trainer's role is to get to know the specific preferences of the individual dogs under their supervision, in order to

find out what kind of reward motivates each dog enough to choose to work. This involves spending periods of time with an individual dog, over repeat encounters, and paying attention to his responses to the environment in order to build up an understanding of his motivators and aversions. This knowledge subsequently shapes the reward system for that individual dog. For instance, during one of Sandy's first 'runaway'[61] training sessions at PVWDC, I observed Jen, her trainer, offer the dog the opportunity to exercise agency with regards to the kind of reward that would be used for the session.

Up on the eerily cold and dilapidated first floor of '227'—the abandoned former paint-factory that shares PVWDC's campus and in which they conduct some of their training searches—I am stood holding on to the end of a leash. At the other end of the leash is Sandy, a five-month-old petite yellow Labrador, with whom we are preparing to practice some runaways. Jen throws several toys—rope tugs, balls on string and plush teddies—onto the ground down the corridor. She tells me to let Sandy loose. As I let go of the leash, dropping it to the floor, Sandy runs towards the toys. Jen calls out to Sandy, "Pick a toy!" After exploring a few of the toys with her mouth, Sandy becomes very interested in a squeaky, fluffy toy; persistently biting it. Watching her, Jen comments, "Ooh it's a squeaker, you like that one?" Sandy hops back over to Jen with the toy dangling from her mouth. With Sandy's reward now established, we are ready to begin the runaway. Jen asks Sandy to drop the toy, which she then picks up and passes to the intern who has volunteered to play the 'runaway'. He takes this with him as he goes off to hide in a room down the corridor and uses it to reward Sandy when she finds him.

Acknowledging the individuality of the dogs, the trainers attempt to afford space for the dog to make choices with regards to the training rewards. Although Sandy, the dog in the above example, is not a dog in training for medical detection per se, similar practices of reward choice occur throughout the search specialties at PVWDC. Whilst dogs

[61] During training of puppy 'runaways', a person acting as a 'runaway'—usually an intern or volunteer—shows the dog a toy before running away, down the corridor and hiding, typically in a cupboard within a room. Once the runaway is out of sight, the trainer then releases the leash from the dog's harness and tasks him to 'Go find'. Prior to commencing the runaway, the dog's trainer tells the hider how many barks to wait for before opening the cupboard, revealing themselves to the dog and rewarding the dog for finding them with toy play.

conducting the task of disease detection, at both organisations, are typically rewarded with food for each correct response[62], a particular, 'favourite,' toy of the dog is often brought out at the end of a session to facilitate play.

ii. Careers and Personhood

In order to reveal further the particular shape of canine agency among bio-detection dogs, in this section I explore how the practices and discourses surrounding the dog's labour are conceived and represented with regards to a terminology of 'careers'. In doing so, I highlight a distinction between the U.K. and U.S. field sites. This discussion also illustrates a case through which evolving ideas of human responsibility towards dogs emerge as key.

Both organisations portray the dogs' relationships with their own labour in terms of 'careers' and their labour is understood as something the dogs have actively chosen, and continue to choose, to do. However, the emphasis on the careers of detection dogs is especially marked at PVWDC, where each dog in the training programme eventually graduates as a specialist in a particular field of scent-detection. This is referred to by the staff as a dog's 'major', mirroring the American university system whereby students get the chance to focus on something they themselves want to study. Thus, especially at PVWDC, where dogs eventually become specialists in one area, it is considered that dogs are active agents in determining their career path. Speaking to members of the public during a tour of the center, Training Director Angela explains:

> "No major is declared until they're older. It's kind of like, we train them and see what areas they work the best in and then we put them in those areas: search and rescue, live find, human remains, police work, explosives, narcotics, bed bugs, cancer."

In order to assess what area a dog is most-suited to, the trainers constantly consider whether, for instance, a dog demonstrates confidence and enjoyment searching for hidden people on the uneven surface of the rubble yard, or if he excels instead at searching samples on the carousel inside the training room. Career decisions are thus arguably shaped by the actions, performances and preferences of the dogs themselves who, under

[62] See note 42 for an explanation of reward variation across the search specialties.

the conditions of the style of positive-training adopted by the trainers, are supported to exercise agency and have their preferences attended to by the humans.

The notion that the individual dogs have an element of choice, or are afforded the capacity to influence decisions, with regards to the particular area in which they will eventually specialize is a matter of pride for PVWDC.[63] It is something that they recognize sets them apart from other dog-training organisations, such as *The Seeing Eye*,[64] where the future career of a dog is pre-determined from the outset. Cynthia even attributes this personalized aspect of their training methodology with the center's extremely high success rate of dog graduates:

> "Right now, 93% of our graduates have jobs. That is in comparison to the usual service dog programmes where it's about 50% of the dogs end up in the careers that were selected originally for them. In the original TSA [Transportation Security Administration] breeding programme, only 30% of those puppies actually made it into the TSA. At the end of their ten-year plan they were up to about 70%, which is a good number but still not close to what we're talking about when we're looking at 93%."

Cynthia goes on to suggests that this element of 'choice' on the part of the individual dog ought to be factored in by the individuals and state organisations (e.g., the

[63] Implicit in the practice of matching dogs to roles they are perceived to desire is an assumption that dogs want to work in the first place. In addition to the previous chapter's discussion regarding the somatically-assessed expression of a dog's will to work, I suggest that this supposition must also be understood in relation to the specific selection and breeding process adopted by PVWDC. The dogs at PVWDC are bred from 'working lines', meaning that they have been selectively bred to participate in high-energy work such as hunting and retrieving. This breeding practice distinguishes working dogs from other dogs who are bred from 'show lines' to confirm to the aesthetics of a breed standard. It is with a recognition of this biopolitical understanding of the breeding of these dogs, as beings with desirable behavioural traits that have been selected for by humans—in other words, animals that have literally been brought into this world to work for *and* with humans—that Cynthia's perception of the dogs as inherently wanting to work must be understood.

[64] *The Seeing Eye* is a charity in the USA and the oldest dog school in the world training guide dogs to live with and assist blind people.

U.S. Department of Defense) who are working to develop a national detection dog breeding programme. Giving a 'Lunch n Learn' presentation[65] at the center one day, she also associates the individualization of careers with welfare issues:

> "Our dogs can have any career they want. So our success rate is based on fitting the dog to a career that works for it. So we can put as many dogs into careers as possible. And I think that if we limit ourselves and say we're only gonna do bomb dogs, we'd actually end up doing a dis-service because we'd end up having dogs that don't fit and then we're gonna have a welfare issue that we're producing an excessive number of dogs and we don't have jobs for them."

Cynthia's articulation of the organisation's goal to match each dog to a career that works for the individual dog reflects a moral standpoint widely shared by my trainer informants regarding their obligations towards the dogs. Namely, this is that it is their responsibility to ensure these dogs have the opportunity to engage their innate desire to work, and to do so under conditions that respond to the individual dog's needs and desires in work that is meaningful to the dog.

This desire to place dogs in careers based on what the individual dog is perceived to enjoy doing is explicitly connected to a notion of the dog's 'happiness': an element of canine subjectivity that the trainers believe they can, and *ought*, as responsible trainers, to nurture. Happiness is clearly considered by my informants to be associated with the dog's perceived agency in the training process. Recall Jen's comment about her previous experience training with methods of force: "They just weren't happy working dogs. They worked because they *had* to." Thus, both choice and happiness are understood as aspects of a dog's subjectivity that, whilst largely elided through methods of force, are, on the

[65] 'Lunch n learn' is a weekly hour-long slot of presentations given by trainers, interns and vet-externs across a variety of topics. For instance, I saw trainers give practical demonstrations of canine stretching exercises, interns give presentations on the data-collection projects they've been involved with and vet-externs talk on topics including canine vision and canine behavioural medications. This event fosters the sharing of knowledge and expertise throughout the PVWDC community. Everybody who is on site that day, including Cynthia, typically attends, eating their packed lunches whilst listening to the presenter.

contrary, acknowledged and encouraged through an emphasis on positive, dog-centered training methods.

Implicit in Jen's comment is an illustration of the recent shift in approaches to dog-training, whereby today, especially in the context of canine obedience sports that Justyna Wlodarczyk (2017) considers, 'It is expected that dogs interacting with humans should look like they are enjoying themselves' (41). Also in the context of dog sports, Leena Koski and Pia Bäcklund (2017) suggest that among dog-trainers, the dog's happiness during a performance is tied to a sense that the task is 'internally' desirable to the dog.

Thus, it becomes the trainer's responsibility to provide the conditions under which dogs are enabled to flourish. Here, the happiness, or joy, of dogs—inferred via attention to somatic sensibilities—is a significant indicator through which flourishing can be evaluated. It is notable that this emphasis on canine happiness has emerged at a time when popular and academic interest in human happiness has peaked in the west (Walker and Kavedžija 2015).

Even under the conditions of positive-training whereby dogs can 'speak back', their happiness is not considered fixed but subject to change dependent on various factors, including the dog's personal biography. This points to another significant way in which the dogs' careers are understood by these organisations, with regard to their temporality: the dog's career is not understood as fixed but changeable over time. For instance, several of the dogs at MDD are described by the charity as 'career-change' dogs. One such dog, Jazz, a prostate-cancer detection dog, was bred by a British guide dog charity. After several months of training in the guide dog programme however, she was assessed and determined to be too inquisitive about odour to make a suitable guide dog. Her keen nose helped to make her a suitable candidate for detection work instead. Additionally, several of the dogs working in the bio-detection department at MDD are 'career-change' dogs within the charity, having transitioned from the medical alert assistance side of the charity. The reasons most commonly expressed, for dogs undergoing this kind of shift in career, pertained to problems with the dog's 'public access' suitability.[66]

[66] All assistance dogs accredited with Assistance Dogs International must undergo a public access test to ensure the dog can work safely and behave appropriately in public settings. The general areas covered by the test include the dog's ability to walk to heel, display obedience to his handler's commands, and not respond with aggression or fear to environmental distractions.

Even within the bio-detection department itself, certain adjustments can be made for individual cases to ensure a dog's happiness in his career. Ed clarified his ethos of finding 'the right job for the right dog' with the example of Ellie, a dog who had recently been assigned a new role within the bio-detection department that requires her to search for odour *outside* of the bio-detection training room. Ed explains the reasoning behind this shift in Ellie's job description, referring to his perception of Ellie's degree of enjoyment in her work:

> "Ellie felt constricted and sort-of confined working the stand system in that bio-room. But take Ellie outside, and you probably saw a little bit last week she really excelled and her tail was going: she loved it. I think finding the right job for the right dog is important and I think they do enjoy it."

Here we see another illustration of how an attention to the dog's somatic sensibilities promotes care-full (Greenhough and Roe 2011) practices, in this case regarding the details of a dog's 'career'. While the previous chapter illustrated the capacity of the bio-detection dog to say 'no' in response to their situation, the example of Ellie's subtler workplace adjustment is a case in which her trainer has responded to a dog who has said 'no but' (Kirk 2017, 218).

While the animals used in scientific research have, up until recently, been regularly conceived of as the researchers' 'tools of the trade' (Birke 2012, 13) and their development described as creating the 'right tools for the job' (Clarke and Fujimura 2002), it is clear that bio-detection dogs—as beings assumed as occupying careers which they themselves help to determine—are, on the contrary, understood and treated by the people working alongside them as co-workers with agency and personhood. Ed explained his perception of the dogs to me during an interview:

> "For me, they're not tools. They're probably co-workers. They're not a piece of equipment with no personality. They all have their personality. And you don't have to adapt the way you use a tool. You have to adapt the way you work a dog. So, for me, they will never be *just* equipment or tools, they will always be colleagues, co-workers."

Thus, explicitly challenging perceptions of animals as passive automata or generic tools, my informants' understandings of bio-detection dogs are consistent with the increasing recognition that many animals are more self-aware and conscious than had previously been thought possible through a lens of human exceptionalism (Birke et al. 2004, 174). More than two decades ago, in 1994, the historian of science, Robert Kohler, hinted at a challenge to the conventionally-assumed binary between scientist and research subject in his fleeting description of fruit flies in the lab: animals he described not only as lab tools but also as the scientist's 'co-worker'. Although Kohler does not expand further on this theme in his work, scholars have illustrated that, in keeping with my own observations, many researchers do not consider or handle their animal subjects as mere tools or instruments (e.g., Dror 1999).

As Kendra Coulter (2016, 70) notes, in her monograph *Animals, Work, and the Promise of Interspecies Solidarity*, 'We cannot simply dismiss animals' roles as passive or see animals as mere instruments for human's work'. Having studied the work done by, with, and for various species of animals, Coulter argues that animals spanning an exhaustive list of working categories (including law enforcement, military, health care, sport and agriculture) should be identified as workers, building her argument by following Ingold's (1986, 88) contention, that 'the domestic animal in the service of man constitutes labour itself rather than its instrument, and hence that the relationship between man and animal is in this case not a technical but a social one'.

Regarding laboratory animals used in clinical trials, Jonathon Clark (2014) makes the case for acknowledging their identity as workers. In developing his argument, he draws analogies with work exploring the role of humans in experimental research. In particular, he builds on Melinda Cooper's (2008) notion of 'experimental or clinical labourers', which she uses to refer to the group of human 'guinea pigs' partaking in clinical trials and often lacking labour rights. This notion is extended by Clark to account for the subjectivity of actual guinea pigs (and other animals). Whilst advancing such an argument however, Clark remains mindful of the human–animal relations of production that these animals find themselves in: a factor that is regularly used by critical animal studies scholars to challenge attempts to extend the category of labour to animals. Indeed, while recognizing that animals might exercise agency in some ways—for instance, cows on the way to slaughter being reluctant to follow the herd—Thierman (2010) suggests that this kind of resistance is limited and related to the fact that 'many animals find themselves within human systems that are constructed so as to ensure a kind of perpetual domination' (98).

However, other scholars remain wholly critical about the notion of animals as workers, or even as individuals capable of exercising some kind of agency. Notably, Zipporah Weisberg (2009) claims that, '[i]n reality, animals in labs are not workers—not even alienated workers—but worked-*on* objects, *slaves* by any other name' (36). Weisberg adds, 'To call them anything else is to gloss over the brutal reality of the total denial of their ability to act in any meaningful way—namely, as self-determining *subjects*' (Ibid., 39). For Haraway (2008) however, the suggestion that animals are not their own 'self-directed' beings does not warrant their preclusion from the category of 'worker'. Considering the case of working sheepdogs, while acknowledging the sheepdog's lack of self-direction, Haraway (Ibid., 55) notes that in fulfilling their roles it is essential that the dogs' 'active cooperation' is enlisted by the human directing the work. Thus, Haraway readily identifies these animals as workers, 'who produce surplus value by giving more than they get in a market-driven economic system' (Ibid.). Nevertheless, Haraway considers dogs neither within the category of 'human slaves' nor 'wage labourers' and argues that their labour should not be theorized within such frameworks: 'They are paws, not hands' (Ibid., 56). For Haraway, the difficulty in analysing these matters relates to the categories for subjects that are expressed in humanist terms (Ibid., 67). Thus, whilst simultaneously emphasizing the status of many dogs as workers and rejecting the analogies of wage labour and slavery, Haraway highlights the lack of suitable nonhumanist conceptual tools and terms with which to analyse these matters.

Understood by their trainers as co-workers engaged in meaningful careers, notions of personhood are projected onto the dogs at both organisations. However, I observe that this is in some ways more pronounced at my American field site, and effected in a way that places greater emphasis on the notion of personhood as being tied to the value of individuality. Indeed, in many ways, PVWDC is a highly individualizing environment for the dogs. This is readily observable, for instance, in the 'veterinary infrastructure' (Irvine 2016) of the individual kennels in which the dogs are kept whilst on-site. Posters are fixed, either on the wall besides, or attached to each kennel with cable-ties, giving a biographic outline of each dog: information that is especially helpful for incoming volunteers who are unfamiliar with the dogs. As well as including a photograph, the dog's name, date of birth, breed, and potential career, the posters detail the dog's requirements, preferences and aversions with regards to diet, toys, and other dogs. There are also specific handling instructions such as harness requirements.

At PVWDC, paper technologies such as these posters are not only used to *give* individualizing information that help construct canine personhood, but also to obtain data that is used to inform understandings of the individual. Various sheets and charts are used to collect data regarding aspects of the dog's health and wellbeing, for instance their weight. Whilst at both organisations, every dog's weight is monitored, this is less routine at MDD in contrast to PVWDC where it is a daily practice, as referred to in chapter 3. This frequent monitoring of the individual dogs here also extends to their toilet activities. At PVWDC, each dog's toilet activity during the day is recorded via a 'potty chart' located on a desk in the kennel area. When returning back from taking a dog outside, the handler is required to note the time the dog went outside and whether the dog urinated or defecated. As a visual tool, the chart helps staff to prioritize dogs who need to be taken out. In addition to ensuring the dogs' basic needs are met, these charts, combined with the activity sheets described in chapter 5, can be interpreted as technologies of surveillance that enable the organisation's monitoring of individual dogs, as well as comparison against other individuals.

The entanglement of individuality and personhood is illustrated at PVWDC in other ways still. For example, when dogs complete their training and are sold on to a handler, for instance within the police, a graduation ceremony is held at the center to mark the dog's transition and a certificate is awarded to the handler and dog team, inscribed with the names of both. Beyond the walls of the center too, it is possible to observe the projection of dog personhood. For instance, in 2016, Cynthia testified in front of the Senate Homeland Security Committee about how to address the country's shortage of 'home-grown' dogs capable of supporting matters of national security.[67] Rather than talk about the work of detection dogs in their absence, Cynthia brought along Zach, the drugs detection dog in-training referred to in chapter 3. As Cynthia gave her testament, Zach sat next to her and was identified with his own nameplate on the desk.

At MDD, although the dogs are certainly recognized as individuals with personhood, and aspects of their health and training exercises are also recorded and compared, these individualizing practices are conducted to a considerably lesser degree

[67] The majority of the nation's service dogs (i.e., military and law enforcement) are currently sourced from Eastern Europe. While the USA did previously have a national breeding programme, operated by the TSA for ten years, this was closed in 2012 due to budgetary constraints (Cusack 2017).

than I observed at PVWDC. This might be explained in part by the American emphasis on individualism which is more extreme than in any other culture (Lasch 1978; Shore 1996). Thus, at PVWDC, personal choice, as a fundamental element of American individualism, is arguably being projected onto the dogs.

In this discussion, rather than a dogs' specialty, or 'career', being framed as a result of the sole agency of either human or dog alone, I have proposed an analysis of canine career choice as a practice that is mutually negotiated by both, as trainers' decisions are informed by the knowledge acquired in the affective encounters in which the parties routinely and repeatedly meet. Furthermore, this discussion has revealed the trainers' sense of obligation they feel towards enabling the dogs to pursue careers that are enjoyable to them as individuals. The following section of this chapter reflects further on this notion of trainer responsibility.

iii. Supporting Bio-Detection Dogs to Flourish

On several occasions during training sessions at MDD, I observed as Neil completely re-organized the formation of the four stands from a straight line into a curve, responding to dogs who were searching the lineup very quickly. He regularly explained adjustments like this, or acts of tinkering as I have proposed, in terms of him helping to 'set the dog up for success'—a phrase that he borrows from renowned American dog-trainer Grisha Stewart. Neil clearly considers it a part of his role as a trainer to give the dogs the best chance possible to make 'good' choices in their work

The manner in which the relationship between the dogs and their labour are framed by my informants—namely, in terms of 'setting the dog up for success', canine choice and happiness—reflects an emergent perspective associated with the shift in training philosophy outlined in the previous chapter. Specifically, my analysis follows Wlodarczyk's (2017; 2018) observation that the shift towards dog-centered training approaches has promoted the development of an ethical impulse among dog-trainers, whereby there is an increasing desire to 'incorporate an appreciation of animal alterity into training practices' (2017, 41). One element of this ethical impulse, that I have illustrated in the practices of my human informants, is an attentiveness to what the individual dogs might themselves want or need to do, or what is recognized as most meaningful to them in order to support their flourishing—both as a species and as individuals.

As Wlodarczyk (2017) suggests, the accommodation of the dog's alterity has been promoted alongside the move towards force-free, dog-centered training methods. This argument resonates with the experiences of many of my informants, for example Jen at PVWDC. Prior to working at PVWDC, Jen had worked for a dog-training business directed by a man with 'old school' methods, in her words. Clarifying what she meant by this description, she explained that tools such as choke chains and electronic collars were routinely advocated by her boss. Reflecting on the differences between this kind of training versus the force-free style she adopts now at PVWDC, Jen points out what she sees as most problematic about the methods prescribed by her previous employer:

> "We didn't tailor our training to meet the dog's needs. The training was tailored to meet the owner's needs, business needs: this was a business, it really wasn't tailored around research. It wasn't tailored around what made the dogs better dogs, happier dogs, more motivated dogs. It was strictly tailored around making money…And he's successful, in his eyes, he's being a successful trainer because his business is thriving so why should he change or do anything differently, because he's getting out of it what he needs out of it. The dogs might not be getting what they need, but he is."

Following a human-centered approach to training in her previous role, Jen was not required to get to know the dogs as individuals. She makes explicit her belief that this organisation was not oriented towards meeting the needs of the dogs but only the capitalist concerns of the business-owner. Such human-centered methods of enforced discipline and punishment arguably inhibit the potential for response-able relations to emerge as no accommodations are made for the dog to speak back nor, significantly, to be listened to. Meanwhile, when methods of force are omitted from the training protocol and the training approach is more dog-centered—fundamentally dependent on understanding what a dog wants the most—the success of training arguably depends on the 'response-ability' (Haraway 2008) of the two parties. Being response-able in their encounters, as I have illustrated in both this and the previous chapters, the trainers demonstrate what Paul McGreevy and colleagues (2017) refer to as 'good dogmanship'. This quality is defined as being 'all about reading dog behaviour and responding appropriately, meeting dogs' behavioural needs and allowing them to reach their full potential in a training setting' (2).

The ethical orientation of incorporating the needs and desires of the dogs into the training practices in order to offer the dog a meaningful life might be considered using what the philosopher Martha Nussbaum (2006) calls the 'capabilities approach'. Nussbaum argues that each animal, with regards to both the species of the animal and the animal as an individual being, has a particular set of capabilities, or capacities for functioning. These capacities include life, bodily health, play, sense/imagination/thought, emotion, etc. In order for the animal to flourish, Nussbaum claims that those fundamental capacities require support from the animal's material and social environment. In keeping with the analysis developed in this thesis, Nussbaum's approach rejects a conception of animals as somehow isolated from their environment.

The capabilities approach considers the capabilities of the animal with regards to its species' basic capacities, while also paying attention to the capacities and personality of the individual. Following Nussbaum, I have observed how many of the dogs' fundamental capacities are supported through the provision of both species-specific and individual care. For instance, I have shown that dogs are understood to have a species-specific engagement with the world, grounded predominantly in their olfactory capabilities. Throughout the ethnographic examples I have presented, it is possible to observe how the dog's capacities for bodily health, play, thought and emotion are attended to.

More than a general knowledge of the dog as a species however, I have also pointed to the specificity with which my informants communicate with specific dogs as individuals, accounting for their personalities and individual preferences when considering a dog's career trajectory. Furthermore, in tinkering with equipment and attending to somatic sensibilities through affective encounters that help to 'set the dog up for success', the trainers demonstrate a perceived obligation to support the dog to achieve his potential in tasks and with rewards that are meaningful to the individual dog.

Nussbaum's argument has also been used to consider approaches to animal welfare (Keulartz and Swart 2012, 132). To this end, I argue that the practice of bio-detection, which offers the dogs an opportunity to engage with and display their olfactory capability—arguably a capacity in jeopardy under the conditions of contemporary pet-keeping, whereby some dogs are deprived of opportunities to utilize their olfactory systems to their potential—represents an instance in which a 'less natural and more human' (Ibid.) environment can still provide the dog with the opportunity to flourish.

iv. Conclusion

More than simply affecting the material reality of particular moments, this chapter has demonstrated that dogs are able to exercise agency surrounding the status of their livelihoods more broadly, conceptualized by their trainers in terms of 'careers'. Considered as beings with choices and careers in their own right—fundamental aspects of life in a Euro-American context that are typically reserved for humans—I have argued that the dogs emerge as co-conversationalists in the shaping of their careers.

Furthermore, in this chapter, I have explored how my informants' response-ability shown towards their dogs' labour illustrates their ethical impulse to offer the dogs meaningful lives: an obligation they endeavor to accomplish through a prioritization of the dog's species-specific and personal subjectivity and capabilities within their training practices. Considering this analysis beyond the spaces of bio-detection dog training, it might be suggested that this ethical impulse reflects a broader shift in sensibilities about human responsibility towards other life forms on this planet, provoked by recent discourse on the anthropocene (e.g., Colombi 2009; Fuentes 2010; Vitebsky 2005).

Additionally, in both their objectives and methodology, parallels can be drawn between my dog-trainer informants and the multispecies ethnographers 'writing in the anthropocene' (Rose 2009, 87) who are concerned with entanglements 'of the host of organisms whose lives and deaths are linked to human social worlds' (Kirksey and Helmreich 2010, 545). For instance, both dog-trainers and multispecies ethnographers are fundamentally concerned with developing a knowledge of the nonhuman and our interconnectedness. With regards to methodology, both maintain an emphasis on sustained interactions with the nonhuman other, with one's body prized as a valuable tool for developing interspecies understanding. Finally, both are committed to a practice of reflexive examination with regards to one's interpretations of the species that they represent.

The discussion presented in this chapter, regarding the provision of opportunities for the dogs to fulfil their individual potential and desires, has alluded to the significance of trainer interpretations about the dog's behaviour and feelings. In the next chapter, I turn the focus to the production and translation of such interpretations, with a specific emphasis towards understanding how these interpretations become scientific knowledge and how they inform representations of bio-detection dogs.

Chapter 7. Producing and Communicating Knowledge: Interpretations and Representations

This chapter explores how the information offered by a detection dog becomes transformed into evidence that is meaningful among humans within and beyond the scientific arena. The chapter begins by detailing how, while a dog investigates odour samples and gives certain responses to them, his trainer attempts to make sense of, or interpret, the dogs' behaviour, employing practices of reading and listening to the dog's body, as outlined in previous chapters. Building on this however, I will illustrate how these interpretations are key to the production of data about a dog's search, via their transformation into 'inscriptions' (Latour and Woolgar 1979). Considering the role of the dog in this process, I illustrate how, during training sessions—which are dynamic and responsive encounters, in contrast to the process of formal testing that is governed by strict conditions—the interpretations trainers make about the dog's behaviour directly affect the course of events in that session. Furthermore, I examine the novel modes of speaking about dogs that are enabled by the inscriptions produced, highlighting the co-existence of multiple diverse modes of representation. Finally, this chapter presents a discussion concerning the efficacy of anthropomorphism as a concept for thinking about the intersubjective practices of interpretation performed by my dog-trainer informants.

To preface the discussions of this chapter, it is worth noting that the data produced in these settings can be broadly divided into two categories: training and research. Firstly, from every training session data is produced which helps to inform trainer's everyday knowledge about their dogs' performance and progress. This is the most common type of data produced, as research trials tend to last only several weeks, whilst training for these trials can span six months or longer. It is however the data produced during phases of formal research trials that informs the findings presented in scientific publications. In each of the examples presented in this chapter I make explicit whether I am referring to encounters during training or trial stage

i. Making Interpretations and Producing Inscriptions

On Alexa's command of "Seek seek," Bertie hurries over to the first position on the carousel and pauses with his nose over the pot for what feels to me like less than a second,

before moving on to search the second, third and fourth positions in the same manner. He weaves his agile body around the carousel arms, with his nose leading the way as he searches each pot in succession before arriving at position five. When sniffing this pot, with his nose still hovering over the steel lid, he drops his bottom to the floor, and his eyes glance up towards the screen behind which Alexa, his trainer, is stood watching. Alexa calls out "indication," to which Ed, sat at the computer desk in the corner of the room, responds "correct." Alexa presses down on her clicker, causing it to exert a short, sharp 'click' sound that lets Bertie know he has made the correct decision and that his reward is imminent. Alexa walks over to where Bertie is sat, his eyes fixed on her but his nose still hovering over the pot. He licks his lips as she gets within a few feet of him. Feeding him some kibble treats from her hand, Alexa tells Bertie he is a "good boy" as he chews.

Meanwhile, at the desk in the corner of the room, Ed taps away on the laptop, entering the data for this 'run'.[68] *For positions one through four, he selects the option 'no interest' to describe Bertie's responses to these samples. He records position number five as 'indication' and for positions six to eight he chooses the option 'not searched'. He then saves this run on the laptop and gets up to set up the carousel for Bertie's next search, switching the position of samples and replacing some with novel ones.*

During every training session at MDD, like the above, data is collected pertaining to the dog's performance. For every sample available to a dog during a search, the trainer must choose one of the following entry codes to describe the dog's behaviour: 'indication', 'hesitation', 'interest', 'clicked straight away', 'no interest' or 'not searched'. While the data categories available to record a dog's search performance are thus limited, in practice a single category might be recorded to account for a variety of contextual circumstances in which the behaviour occurred.

For instance, the category 'not searched' applies to any sample that a dog has not searched during a given pass. For example, imagine a target sample is in position 2, in a lineup of 4 stands. If the dog searches the samples in the successive order in which the samples are presented, successfully indicating at position 2 when he gets there, he is rewarded at this position by his trainer and not tasked to carry on searching the remaining positions 3 and 4. In this case, the dog has made the correct decision by searching the samples in order and stopping at the target. Positions 3 and 4 would be recorded as 'not

[68] A 'run' is the term used to refer to each novel lineup of samples.

searched', but in this instance the absence of a search is not problematic as the dog has done his job correctly. Sometimes, however, the reason for recording a sample as 'not searched' is not because the dog has already found the target. Indeed, there is not always a target to find when dogs are trained to clear 'blank' lineups.[69]

Furthermore, given that dogs are not passive tools but behaving creatures, their behaviour is often more nuanced than is reflected in the generation of inscriptions (Latour and Woolgar 1979) about their searches. For instance, an 'indication' is called by the trainer when a dog offers his 'trained alert response', or the behaviour—commonly, but not always, a 'sit'[70]—that he has been trained to perform when he smells and recognizes his target odour. However, sitting on the identification a particular odour is not typically the response a dog is inclined to spontaneously offer, and thus requires training. Achieving a 'clear' and consistent alert response when the odour itself is subject to variation can be challenging, with the precise response offered by dogs differing subtly between them. Thus, the trainer's interpretation is required to make sense of the dog's behaviour.

Additionally, individual dogs often respond in slightly different ways to differences in odours. Recall, for instance, the training session between Ed and Lola detailed in chapter 4, whereby Lola moved her body away from control samples in different ways depending on the particular contents of the control. Thus, the nuances of dog's indications, and search behaviour more generally, are an important aspect of the dog that the trainer must learn about in order to make 'correct' interpretations. However, when the dog's search behaviour is recorded, these more nuanced characteristics are essentially banished from the resultant data. This disparity was explicitly recognized by Simon at MDD, who mused, whilst looking over data pertaining to the searches of a particular dog on a computer spreadsheet, "When you look at the data, you don't see how the dogs performed. You see the results, but not how they've performed."

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[69] See note 43 for a description of blank lineups.

[70] When I asked trainers at MDD about their thoughts on trained alert responses, for instance why they train a dog to sit at the target instead of a different behaviour, they told me that, in principle, they do not mind what behaviour a dog uses to alert with, so long as it is 'consistent' and 'clear'. Following instruction from the charity's CEO however, there is an inclination towards 'sit' alerts, as this is considered to be a much less ambiguous behaviour than a standing alert. A dog in a seated position is also a clear visual response for those groups of people outside this niche field of training and research—including academic research collaborators and members of the public—to observe.

For the trainers, understanding how the dogs are performing is dependent on their own skilled bodily craft in listening and responding to the dogs. During training sessions, their interpretations about the behaviour of a dog are routinely used to shape the training session, highlighting the agency of the dog in this process. To illustrate how interpretations can be observed to inform the training, I draw on an example from a training session with Dougie at MDD that ties together many of the topics discussed in this thesis. In this session, the four stands are currently blank, comprised of control samples. Alexa, Dougie's trainer, is working unblinded, meaning that she is aware of the composition of samples. The following excerpt begins ten minutes in to the training session.

Dougie searches positions 1, 2 and 3, successively, showing 'no interest' in any of these samples. Before reaching position 4 however, he turns away from the line of stands and walks back to Alexa, his trainer, stood towards the beginning of the lineup. The data category recorded for position 4 of this pass is thus 'not searched'. All four samples are controls, but to receive a reward, Dougie is required to search all positions and only then return to his trainer to indicate that no target is present. Dougie has failed to search all four, thus not correctly performing his search, and Alexa does not reward him. She and Ed try to make sense of Dougie's actions:

Alexa: "He knows, doesn't he?" [That it is a blank lineup].

Ed: "He's memorized the set. Is he being clever or trying to shortchange you?"

Alexa and Dougie leave the room for a minute or so and wait on the other side of the door whilst Ed takes a target sample from the side and places it in position 4, removing the control sample from this stand. He explains to me that his plan is to teach Dougie that even when it appears as though the lineup is looking likely to be blank, it is always worth searching every position.

Hearing Ed call out 'ready', Alexa and Dougie come back into the room. From the starting position, behind the screen, Alexa tasks Dougie to search. On this pass, after searching stands 1, 2 and 3, he returns to Alexa's side, skipping position 4 again. Alexa asks him to sit, which he does. After a three second pause, she sends him to search the line again. On this second pass, he searches each sample in turn until he gets to position 4, which he sniffs and correctly indicates by moving his bottom to the floor.

Alexa: "Good boy! You weren't expecting that were you...Got to search them all, see!"

This example illustrates how, during training, a trainer's interpretations directly shape the course of events. In this case, Dougie's behaviour clearly affected Ed, as Ed's interpretations of Dougie's actions, as a case of second-guessing the lineup, demonstrably shaped Ed's decisions with regards to the composition of the subsequent lineup. Specifically, Ed was forced to reflect on how Dougie was working and, consequentially, what Ed could do to best teach him, or as his colleague Neil would often put it, to 'set the dog up for success'.

Ed and Alexa's interpretation of Dougie's behaviour as guesswork is associated with the notion, often expressed to me by trainers, that many of the dogs are thought to be able to memorize the set of samples used during a given session. Due to limitations of sample availability that affected both of my field sites during my time in the field, usually a single set of samples was used during a training session, meaning that a dog will sniff many of the same samples several times during one session. The composition of each run within a session is kept distinct however, as sample positions are typically changed between runs and some novel samples are usually introduced throughout the session. However, being exposed to the same samples on more than one occasion, it is thought that dogs are able to memorize the sets of samples and can thus begin to anticipate the lineup composition before having searched all positions. Furthermore, as a result of working on the same 'game', with the same trainers and helpers—and hence, the same human bias—several days per week, the dogs are also thought to be able to learn to pre-empt when a 'blank' lineup might be coming up. To reduce human bias during training sessions, computer-based random number generators are sometimes used to randomly decide the lineup of samples, in particular when working with dogs in the more advanced stages of training.

Trainers talk about this capability in somatic terms, describing dogs who they interpret to be engaged in guesswork as 'depending on their head' rather than their nose. For instance, commenting on the search behaviour of a dog with whom he had just worked, Simon remarked, "What he's doing is fine, as long as he's using his nose and not his [Simon points his finger to his own head] or that [points his finger to his eyes]." Among my informants, 'head' is used synonymously with mind or brain, and too great a reliance on one's head is often thought to come at the expense of the dog's methodical investigation of the odour which ought to be directed by his nose. As Kelly referred to a dog she was training, "I think at the moment she's working on memory and behaviour, rather than odour. She expected it [the target] to be there."

However, this is not to say that the trainers do not consider the dog's mental capacity important in his search. Discussing Lola's search behaviour between runs one day, Ed commented, "She's just got to be in the right frame of mind. And at the minute she's not…it's 'cause she's not engaging her brain at [positions] 1 or 2." Thus, a dog's mental capacity is clearly considered an essential element of a detection dog, but it is also understood to be a potential hindrance if the dog's behaviour is not being fundamentally guided by his nose. Ideally, therefore, trainers want dogs to use a balanced combination of their 'nose' and 'head' during a search. Whilst they want the dog to offer a particular trained bodily response to the target odour, they want the more spontaneous odour-recognition to be the driving force behind this response. It might thus be said that, as detailed in chapter 4, trainers want the dogs to be *affected* by the target odour.

Attending to how a dog communicates his capacity to memorize, or his 'frame of mind' in a given moment brings into focus the individual dog's subjective experience of the world and recognizing their state of being is a practice dependent on the cultivation of response-able relationships (Haraway 2008, 71) between trainer and dog. Kirk (2013) makes a comparable argument in his reference to mine-detector dog handlers' acknowledgment of their dogs' 'boredom' in performing work that is extremely repetitive. For Haraway, response-ability is vital if interspecies relationships are to move beyond oppression or objectification. Her argument is informed by Despret's (2006) insistence on the role of 'interest' in shaping how we pose questions of animals. The basic principle of STS, that methods and their practices do not merely help to describe reality but also help to produce the reality that they seek to understand (Law 2015), is extended by Despret into the realm of animal studies in her 2006 essay 'Sheep do have opinions'. Using the example of the ethologist Thelma Rowell's practice of giving her flock of sheep an extra bowl of food at meal times, Despret illustrates that the manner in which questions are posed to animals is not detached from the responses given. The reason for providing the group of 22 sheep with 23 bowls of food: it offered grounds for new possibilities. By providing the sheep with an extra bowl, Rowell had offered sheep the opportunity to do something other than merely compete over resources.

For the handlers of mine-detector dogs, Kirk observes that acknowledging the mine-dog's boredom presented them with a level of flexibility with regards to interpreting the dog's behaviour, as well as altering material practice through the introduction of variety to the dog's everyday work environment. In a similar way, I have demonstrated

that ascribing the practice or memorization to bio-detection dogs leads to dynamic adjustments in the material practice of training.

Whilst a dog's memory and the associated practice of anticipatory guesswork might sometimes be thought to contribute to their decisions during training, the potential to draw on these capacities is eliminated when the stage of double-blind testing is reached. In formal testing, a dog only ever investigates each sample once, thereby ensuring that the scientific data relates only to the dog's first exposure to each sample. Although the trainers expressed a desire to train in this way in the everyday, thus mirroring the strict conditions of testing, sample limitations often make this impossible. Exceptions are made, however, for the sessions in the week or two prior to testing, for which extra samples are put aside in order to get everybody—humans and dogs—practiced for the 'real thing'. In their everyday training sessions too, the trainers adopt other practices in an attempt to reduce the potential for dog guesswork: in addition to the use of random number generators, two distinct sample sets are sometimes intermittently switched between over the course of one training session.

In the process of training, therefore, rather than simply observing and reporting from afar, the trainers' interpretations help to construct an understanding of why a dog might be working in a particular way and how they can help guide that dog towards the refinement of his search practices. Via the categories used to record the dog's actions however, for instance in the above example, the trainer's subjective interpretations of the dog's behaviour, tied to his assumption of the dog's guesswork and use of memory, are omitted. Thus, whilst the practice of interspecies intersubjectivity is integral to the interpretations made by the trainers and training decisions, the rich detail of these affective encounters is substantially collapsed in the simultaneous production of inscriptions—in the form of data categories—and the subsequent 'written traces' (e.g., statistics, graphs and tables) that reduce a dog's performance to a combination of statistical units. Following Latour and Woolgar (1979), one might argue that the computer, as an inscription device with its prescribed categories, removes the data from its original context, and via the 'written traces' produced, the data appears as 'raw nature'. The result is that a dog's behavior, or performance, is standardized according to a fixed set of categories.

According to Birke (2007 [1994], 328) it is the inscriptions 'that create 'data', the facts of the scientific experiment, and help to create an air of authority about those data'. In the process, she claims, the animal under study shifts 'from a behaving being to

becoming data' (Birke 2012, 5). Birke's argument builds on the earlier work of Lynch (1988), who, in his ethnographic research about neuroscientists studying rats, observes a contrast between, in his terms, everyday notions of the 'naturalistic animal' and the 'analytic animal'. For Lynch, the naturalistic animal refers to 'the animal in ordinary perception and interaction; the animal of common sense, the animal as it is viewed and acted upon in the world of everyday life' (Ibid., 267). It is the naturalistic animal that the neuroscientists in his study set out with and continually returned to in everyday conversation. Meanwhile, the analytic animal, is 'ostensibly an artefact; a product of human intervention' (Ibid., 270).

Lynch notes how various 'rendering practices' enable the transformation of the living animal into the cultural object, 'data'. In the context of the laboratory, this involves the 'sacrifice' of the animal[71]: 'a pivotal moment in the rendering process' (Lynch 1988, 274). Through the sacrifice—a significant ritual in the case of the rats Lynch observes involved in neurological experimentation—the animal's body is literally carved up and presented as biological material on a slide. Lynch compares this rendering process in laboratory work to the transformations of animals inside the slaughterhouse, where the domestic animal is transformed into the cultural object, 'meat' (Ibid., 273). Through these processes, he suggests that the naturalistic animal is transformed into an analytic object of research: a 'ritual' object with a 'capacity to synthesize and circulate meanings from many domains and specific situation contexts' (Ibid., 273).[72] However, while Lynch assumes that naturalistic animals reside in the laboratory and are transformed into analytic beings in their deaths, Simone Dennis (2011; 2013) offers a more complex analysis of the relationships between rodents and scientists in the laboratory, based on her ethnographic research conducted in the USA. In particular, Dennis (2013) argues that 'animals in the lab are analytic well prior to their arrival in the lab' and that 'naturalistic animals also emerge at the point of sacrifice' (511).

Of course, in the scent-detection studies conducted by my informants, dogs are not physically sacrificed in the pursuit of data, or in the associated production of an analytic animal. Whilst the practice of sacrifice is an inevitable feature of much research involving

[71] See also Svendsen and Koch (2013) who explore the sacrificial practice of piglets involved in experimental neonatal research.

[72] Lynch quotes Munn, N. (1973) 'Symbolism in ritual context: aspects of symbolic action.' In J. Honigmann (Ed.), *Handbook of Social and Cultural Anthropology.* P. 580. Chicago, IL: Rand McNally.

animals studied under controlled conditions, Lynch acknowledges that it is not always a feature of the rendering process of scientific practice. Indeed, the particular kind of scientific enquiry my informants are engaged in is concerned with a certain aspect of the dog's physiological capacity—the olfactory system—as well as his ability to communicate information about what he smells, thus fundamentally requiring the animal to be alive and permitted with the capacity to respond, throughout both the training and formal testing processes. Instead of sacrifice as the rendering practice through which the dogs might be said to move towards what Birke (2007 [1994], 328) terms 'becoming data', I identify the rendering practices involved here as the training practices, detailed throughout this thesis, through which dogs learn to be affected (Latour 2004) by subtle contrasts in odour.

Here, in the rendering practices of bio-detection dog-training which enable the dogs to become *beings with*[73] whom data can be yielded, the dog's capacity to respond (i.e., the very ability that is inevitably destroyed through practices of sacrifice) remains fundamental. In other words, it is only as a consequence of these practices, in which the dog is considered a sentient individual, capable of responding and shaping the training practices, that dogs can become beings who can be treated analytically. Thus, I argue bio-detection dogs can be understood as simultaneously occupying both categories of naturalistic and analytic animal.

As bio-detection dogs are not required to undergo a practice of sacrifice, it might be assumed that these animals evade a radical corporeal transformation in the rendering processes, when compared with the rodent subjects of laboratory experimentation or those animals slaughtered for meat under conditions of factory farming. However, through the 'subject-changing' nature of the training process (Haraway 2008, 57), I have demonstrated that these dogs nevertheless undergo a transformation that offers the dogs new possibilities of being and behaving.

To consider what makes distinct the process through which bio-detection dogs, as animals of scientific study, become beings who can be treated analytically, from the rendering practices of other areas of interspecies scientific enquiry, we can return briefly to consider the status of the animal's individuality, discussed in detail in chapter 5.

[73] I eschew 'bodies' for 'beings' and 'from' for 'whom' to emphasize that the dogs are certainly not understood, nor treated, as mere passive 'bodies'. Rather, they are agents in the training process.

According to Lynch (1988), the individuality of an animal—including his 'subjective' attributes—is widely considered to be abolished as animals move into the analytic category. For example, describing the modes in which laboratory rodents are articulated as data, Thierman (2010) notes that these animals are 'reduced to particular gene effects of physiological responses. One forgets that these laboratory rodents remain living creatures. They come to be identified with their provision of information, disappearing in effect, as individual animals' (106-7).

On the contrary, I observe that in the trainer's process of producing interpretations, the dogs are not handled as identical cases, but are treated significantly as individuals. I have illustrated above that the dog's capacity to respond in training and research practices is facilitated in multiple ways: firstly, by the specific area of scientific enquiry that fundamentally necessitates the dog's response-ability for the generation of a particular kind of knowledge and, secondly, through the particular training methods used to transform dogs into research participants, in which the dogs are revealed to actively shape the course of events. This has been exemplified both in the above example with Dougie and also in the discussion of tinkering within training more broadly, in chapter 5. However, the dog's individuality—maintained, as I have argued, in the trainer's practice of generating interpretations—is called into question in the representations of the dog that are afforded by the data collected, as discussed in the following section.

ii. 'Biosensors in Fluffy Coats': Moving the Bio-Detection Dog Across Social Worlds

In the process of producing written traces, in which the animal 'becomes data' (Birke 2007 [1994]), it has been observed that new ways of talking about animals become possible (Ibid.; Lynch 1988). According to Lynch (Ibid.), the 'analytic animal' is spoken about in distinct ways from the 'naturalistic animal'. With regards to the rats involved in the research he observed, Lynch describes that once the rat's brain had been sectioned, sliced and rendered into material on a slide, scientists were able to talk about the animal in distinct ways, making comments such as 'that was a good animal'. For these scientists, the notion of a 'good animal', referred to a good set of results from a well-prepared specimen, and Lynch suggests that this observation is distinct from our common-sense, or naturalistic, thoughts of other species.

Certainly, as a result of the inscriptions produced about bio-detection dogs, new ways of speaking about these animals emerge. In particular, in formal analyses of the data—such as the publications that emerge from the studies—the dogs are represented in statistical terms in relation to the odour samples. The contrast between this mode of speaking about the dogs and the everyday mode in which dogs are understood and treated as living and thinking beings, can be highlighted by returning to the aforementioned example involving Dougie. To recap, during Dougie's training session, he was interpreted by the trainers as a minded being who failed to search position 4 because he was anticipating a blank. As a consequence of the written traces produced in this session and recorded on the computer (i.e., 'Run 5, Pass 1, Position 4: not searched') that create the 'facts' of Dougie's detection accuracy, it becomes possible for Dougie to be spoken about in statistical terms that describe a dog's general search accuracy. For instance, in producing a statistical analysis of Dougie's accuracy, the trainer's interpretation, that on this particular run 'Dougie skipped a stand because he thought the lineup would be blank', effectively disappears. The outcome, for example, might appear as 'Dog 1 has a specificity of 70%'. Whilst the dog of the naturalistic kind preserves his individuality in the training practices that render him available to scientific inquiry, in the shift to analytic animal his individuality is diminished in representations such as this.

In keeping with the conventions of empirical scientific publishing, it is this statistical mode of representing dogs that is dominant in scientific publications. As Latour (1987) notes, scientific accounts are not guided by an imperative to detail meticulously what happened, but rather to inform and respond to particular critics. This novel representation of the dogs, enabled by the written traces, can be analyzed here in terms of what it *does*. Specifically, the statistical representations permit comparison: figures and statistics regarding the accuracy of detection dogs can be compared against those of current 'gold standard' medical diagnostic tests. For example, the dogs involved in testing are discussed in the scientific publications in terms of their rates of sensitivity and specificity[74] which are offered as percentages and presented in graphs. This can then be compared

[74] 'Sensitivity' refers to the ability of a dog to correctly identify those samples from patients with the disease, or the proportion of positive samples the dog indicates. 'Specificity', on the other hand, refers to the ability of a dog to ignore those patients without the disease, or the proportion of the dog's alerts which are correct. Put another way, a test with a high specificity produces low rates of false negatives. It is in these terms that clinical tests are evaluated within the scientific literature.

against the specificity and sensitivity of current 'gold standard' tests, such as the prostate specific antigen (PSA) blood test used in the prostate cancer screening process, or urine cytology that is sometimes employed in the diagnostic process of bladder cancer.

As well as statistical representations, the language used to represent the dogs in scientific accounts frequently portrays them in mechanical terms; again, challenging the commonsense understanding of them as feeling and thinking beings. For example, in a published account of their research findings, one research group (whom I did not observe in the field) make several references to the dogs involved in their study as a 'rigorously trained canine olfactory system' (Taverna et al. 2015, 1382). I also observe other contexts beyond the text of published accounts in which it is possible to observe these more mechanical portrayals of the dogs. Typically, this kind of representation occurs in attempts to communicate the practices of bio-detection dogs to social groups beyond this niche field. For instance, listening to Claire explain to visiting members of the public how the dog's olfactory system works, she invokes a systematic notion of the dog, or more specifically, a part of the dog—his nose—as a 'biosensor':

> "Why would the dog be so good at this? [at detecting the odour of human disease]? It's not too hard to imagine. The dog's nose is a biosensor provided by nature. This is Daisy [a photo of Daisy's face is projected onto the screen behind Claire][75]. She's got her nose on the front of her face. She's got three hundred million sensory receptors dedicated to olfaction and us humans have five million. She's also got a second nose at the back of her throat called the organ of Jacobson and that is believed to screen larger, almost pheremonal length volatiles, so long hydrocarbon chains. What she does when she goes to sniff, she sniffs once and if she's interested, if you slow it down, she sniffs twice. So she sniffs into her nose and she also sniffs up into the back of her throat. She's got two different parts of the brain working out what she's sniffing. Unlike us with only one part of our brain, she's actually comparing it."

[75] Daisy, a fox red Labrador, is Claire's personally-owned dog who is trained to detect bladder cancer

Claire's reference to the dog's nose as a biosensor, and her description of this system as a combination of physiological parts, offers an explicitly mechanical understanding of the dog. Representing the dog, or more specifically, the dog's olfactory system, as a set of mechanisms enables her to make comparisons about canine olfaction against that of humans, which she also represents as a biological system. Combined with statistical representations, this mode of communicating about the bio-detection dog is especially significant for this context, given the skepticisim that has surrounded the notion of dogs as an adjunct to diagnosis. Talking about bio-detection dogs in statistical and mechanical terms, in keeping with the conventions of scientific research, whereby the animals involved are commonly depersonalized and de-individualized in their representation (Birke 2004), arguably lends a sense of authority to this field.

In Eileen Crist's (1999) study of the history of the representation of animal behavior, she demonstrates how the language used to represent animal behaviour has consequences for the credibility afforded to a particular account. For instance, she notes how the use of 'technical' language, that enables a portrayal of the animals as 'natural objects', helped afford the pioneers of ethology credibility to their work and legitimise ethology as a subfield of biological science. The language used in scientific accounts of bio-detection dogs similarly draws on a technical vocabulary; as sniffing behaviour is described with reference to the 'encoding…of a stimulus' (Concha et al. 2014). In such representations, the possibility of a dog's inner experiences is pushed aside in favour of a more detached portrayal of the animal's performance. In effect, the dog's behaviour is articulated as the effect of a pre-conscious response to stimuli, rather than the actions of minded organisms.

So too in the representations of the bio-detection dog that are presented to the public can we observe the use of technical language. In the aforementioned explanation of the bio-detection dog's sense of smell, Claire employs a degree of technical vocabulary as she refers to the dog's nose, in isolation, as a 'biosensor.' However, co-existing alongside this mechanical representation of dogs is a perception of the dog as a being with whom one can build an intersubjective relationship: implicit in Claire's references above to the dog as being 'interested', or 'comparing' odours. It is also not by chance that the photograph projected onto the screen during this part of Claire's talk is of Daisy, her own dog, rather than another or a nonspecific dog. Indeed, this is the dog whom Claire credits with saving her own life with a spontaneous alert to Claire's breast cancer in 2009. It is

through this personal experience that she understands the significance of human–dog intersubjectivity in the detection of disease.

Thus, whilst described akin to biosensors, there remains an accompanying emphasis on the sentience and 'dogness' of the dog, rather than an illustration of the dog as a wholly machine-like entity. This ambivalence was emphasized during another of Claire's talks to visiting members of the public, in which she referred to the dogs as 'biosensors in fluffy coats': a phrase that epitomizes the boundary-crossing that characterizes work with bio-detection dogs.

Whilst, in the communication of this scientific field, the dogs are in many ways represented as 'data', I have argued that these representations exist alongside examples of what Lynch (1988, 282) refers to as 'self-explication', with regards to the everyday perceptions of dogs that are tied to the trainer's interpretations of their dogs' actions as well as their understanding of the practice of bio-detection dogs more broadly. Here, this self-explication refers to the lived and experienced relationship between trainer and dog: the precise intersubjective relationship from which I have argued data emerges in this context.

In a publication based on research conducted at MDD (Concha et al. 2014), the authors explicitly acknowledge that the accuracy of the detection[76] depends not only on the dog's ability but also the skill of the handler in making sense of the dog's behaviour. They write, 'In detection dogs, the accuracy of the detection depends on both the dog's olfactory capability to identify the target odor and the interpretation of the dog's behavior by a handler' (Ibid., 752). The notion of detection accuracy as interdependent on the skills of both partners is routinely acknowledged by my informants. For instance, during a team meeting at MDD, Simon commented, "Alert response varies between dogs and it's up to the interpretation of the dog, as interpreted by the handler who has trained the dog." In his analysis of the creation of mine-dogs in the mid-twentieth century, Kirk (2013, 9) makes a similar observation, noting that only the proficient handler, 'sensitive to the subtle working habits of their individual dog, was judged capable of interpreting this behavior and thus recognizing when, and when not, to trust the mine-dog'.

In this section, I have identified representations of the dog as, one the one hand, naturalistic and, on the other, analytic, as simultaneously engaged with in the communication of

[76] Assessed according to the sensitivity and specificity rates of the dogs.

scientific knowledge regarding bio-detection dogs. I have suggested that the depictions of dogs and their skills as analogous to mechanical devices, or in terms of statistical units, are representational practices in keeping with the conventions of scientific publishing. Assessing what this representation *does*, or the consequences of such representation, I suggest that its familiarity helps to facilitate the translation of bio-detection dog research across the differing social worlds of dog-trainers, scientists and the general public, providing an air of authority to this field. However, I have shown that this representation co-exists alongside an everyday perception of the dog as a behaving being whose detection accuracy is tied to his trainer's capacity for interpretation and translation across species-specific sensory worlds. Thus, I propose that the 'analytic object' (Lynch 1988) at the center of this scientific enquiry ought to be recognized more aptly as the collective human–dog detection dyad—a team whose members work interdependently to produce knowledge about odour, disease and its detection—rather than the dog in isolation. In advancing this argument, I do not intend to devalue the dog's species-specific skill so as to emphasize the role of the human. Instead, I offer an analysis that highlights the independent work performed by both partners, whilst simultaneously acknowledging their mutual response-ability, or interdependence, as critical in the joint production of knowledge in this context.

The notion of an animal being both analytic and naturalistic in the construction of scientific knowledge is presented in Daniel Todes' (1997) work examining the use of dogs, in Pavlov's physiological laboratory work, to study the activity of gastric secretions. Using archival materials, including dissertations produced by Pavlov's co-workers, Todes explains how, in one sense, the dogs were certain kinds of 'machines'; imagined and constructed via surgical operations in the laboratory. Some were, for instance, fitted with fistulas to enable the collection of gastric secretions. These dogs were thus particularly constructed technologies, fabricated to produce something else. However, this characterization of, what Todes terms, the 'dog-as-technology' is demonstrated to have existed in tension with an interpretation of the 'dog-as-organism'. This latter depiction of the dogs is tied to the dog's status in the experiments as a living and complex organism, for Pavlov's experiments only took place once the animal had recovered from surgery and regained its 'normal' physiological state. The assessment of such 'normalcy' was a task assigned to Pavlov's co-workers who took into consideration a dog's weight, temperature and 'happiness'—perceived through attention to factors such as a dog's appetite and energy. As a result of the perceptions of each dog as an individual character, Todes explains how interpretive flexibility was crucial to the practice of interpreting

experimental data. Certainly, the experimental practices and uses to which Pavlov's dogs were put differed to those of bio-detection dogs: in order to become research subjects, the bodies of the latter are altered not through physical manipulation, but through training practices that affect the dog's subjective engagement with the world. However, like Todes' analysis of Pavlov's dogs, the bio-detection dogs are also particular kinds of animals-in-research under construction in the training centers, with the intent of producing something else: scientific data. Whilst utilized as tools, the handlers working the dogs simultaneously recognize them as living beings with social relations between animal and human.

Drawing on Mol's (2002) discussion of the multiplicity of the medical condition atherosclerosis, which she demonstrates is *done* differently in the spaces of the outpatient clinic and in the department of pathology, the bio-detection dog can too be considered a 'multiple' being: described and 'done' differently in the various settings of training room, scientific publication, public demonstration and foster home.

Furthermore, I have shown that the way the bio-detection dog is represented in relation to even a single human social group often entails ambivalences and overlap. Thus, the bio-detection dog is, at once, some or all of a multiplicity of beings: a co-worker, with agency and a career in his own right; a statistical unit; a research participant; a companion; a pet or a family member within posthuman families; and a lifesaving hero. I suggest that the various meanings co-exist because of the significant boundary-navigating that this work entails, challenging traditional categories of 'research animal', 'working dog' and 'pet', as well as the distinctions between them. However, whilst the bio-detection dog embodies a multiplicity of meanings, underpinning them all is, arguably, a concept of 'dog' which enables the bio-detection dog to function as an interface or 'boundary object' (Star and Griesemer 1989) between otherwise disparate social worlds. As boundary objects, the bio-detection dogs are 'plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites' (Ibid., 393).

In sum, the analysis developed in this section has highlighted the ambivalences at the heart of interpreting and representing bio-detection dogs: contradictions that I have suggested are tied to the boundary-crossing nature of this practice. One mode through which the boundary between human and animal is arguably challenged is the process of anthropomorphism, discussed in the following section.

iii. Intersubjectivity: Moving Beyond Anthropomorphism

In Alexa and Ed's interpretations of Dougie's behaviour presented in the first section of this chapter, the trainers inferred that Dougie was guessing that this lineup was a 'blank': thus, explicitly attributing a sense of mindedness to Dougie. The trainers' routine intersubjective practices of forming and expressing interpretations such as this offered me, the ethnographer, frequent and unprompted insight into how they make sense of their dogs' actions.

Interpreting the behaviour of the dogs in this way is clearly premised on an assumption that developing an understanding of the subjectivity of others, even animals, is possible, despite sometimes being difficult. As Kohn (2007, 7) notes, based on his observations of the Amazonian Runa people's ability to engage in complex intersubjective practices with dogs, it is 'the belief that we can know the intentions, goals and desires of other selves', including animals, that 'allows us to act in this world'. However, as Kohn recognizes for the Runa, engaging in intersubjective practices with nonhumans entails the negotiation of boundaries and the blurring of categories. Boundary-crossing is notoriously risky business, as Stephen Lyng (1990, 855) argues with his concept of 'edgework', which he defines as 'high-risk behaviour involving, most fundamentally, the problem of negotiating the boundary between chaos and order'. The risk, for my informants, of navigating the boundary between human and animal that is entailed in the process of interpreting a dog's behaviour, is that they stand to be accused of anthropomorphism.

The charge of anthropomorphism, with regard to scientific accounts of animal behaviour has been used in attempts to 'undermine the credibility, or realist force, of accounts that in some way picture animal life and human affairs as permeable to one another' (Crist 1999, 7). Highlighting the connection between the language used and the issue of animal mentality, Crist demonstrates that representations of animal behaviour have tended to alternate between two quite distinct styles of narrative. Firstly, among the work of natural scientists (including Darwin), Crist points out accounts that attempt to present an illustration of an animal's inner life. In this narrative, the animals are emphasized as active subjects and there tends to be reference to the presence of the observer as an interacting being. An alternative style exists however, whereby the researcher attempts to objectify nature from a distance. In this narrative, Crist notes that technical terms tend to be used to achieve a separation between the worlds of human and animal. For instance, 'stimulus-response,' from behaviorism, or 'innate releasing mechanism,' from classical ethology. For Crist, these distinct styles of writing about

similar behaviors highlight the significant role of language in either permitting animals to be portrayed as subjects or prohibiting this possibility. In other words, and to use Crist's terms, the language employed can offer alternative ways of 'seeing' the animal.

Attitudes towards animal mentality vary across different cultures and disciplinary viewpoints, centered around ideas of the distance or alignment between human and animal worlds. Some critics of anthropomorphism, including Thomas Nagel (1974) maintain that humans can only ever know a *human*-perspective of the world, and it is thus impossible for humans to know the world through the minds of animal others.

For the animals themselves, there are potential negative consequences for those who are treated under conditions of anthropomorphism: owners may feel rationalized in punishing their dog for something they wrongly believe the dog 'knows it has done'. Certainly then, the effects of anthropomorphism can be detrimental to the welfare of animals if they're assigned responsibilities that the animal is both unaware of and unable to act accordingly to.

However, particularly during the last two decades, anthropomorphism has become increasingly recognized by some as an instinctive human tendency, given that interactions with other animals, especially pets, are not only frequent but also emotionally meaningful for people (e.g., Bekoff 2007; Sanders 1999). For instance, Sanders and Arluke (1996) explored the routine practice in western cultures of owners 'speaking for' their dogs. Furthermore, the ability and will of humans to empathize with animals, particularly dogs, is thought to be a factor in motivating us to want to care for them, leading cognitive archaeologist Steven Mithen (1996) to suggest that the domestication of animals would not have occurred without anthropomorphism. Thus, Mithen claims that our ability to think like animals, to put ourselves in the place of an animal, was instrumental in our ancestor's ability to succeed the Neanderthals. Mithen (Ibid.) even suggests that anthropomorphism is one of the defining characteristics of the brain of *Homo sapiens sapiens*, evolving some 100,000 years ago. These claims have been well-received by other scholars of human–animal relations (e.g., Serpell and Paul 2010).

The recent shift regarding sensibilities towards anthropomorphism is, in part, attributable to the emergence of fields including cognitive psychology and ethology that have contributed to a rethinking of the perception of animals in the scientific arena (e.g., Bekoff 2007; de Waal 2006). As Michal Pregowski (2015) notes, with the insights developed in these fields, today it is widely acknowledged that 'nonhumans have intentions and sophisticated emotions' (533). These developments have shaped recent

thinking surrounding anthropomorphism, with a growing recognition of the nuances of anthropomorphic approaches. Pregowski explains:

> Anthropomorphism ceased to be seen solely as a form of delusion or wishful thinking with regard to animal capabilities; instead, it was divided into *sentimental* or naive (the 'furry little people' discourse) and *critical* (embracing the complexity of nonhuman animal emotions, while acknowledging the existence of differences between nonhumans and humans). (Ibid., emphasis added)

In this discussion, I follow Pregowski's contention that due to the vast complexity of human–dog relationships, they 'cannot be attributed to sentimental anthropomorphism only' (Ibid., 534). Certainly, in the routine practices of interpreting that I have detailed throughout this thesis, the trainers are observed to 'speak for' (Sanders and Arluke 1996) the dogs, attributing mental states and feelings to them. However, I argue that the trainers resist understandings and representations of dogs as mere 'people in disguise' (Serpell 2005) and thus present a challenge to an analysis of their practices that would consider them as examples of strict, or sentimental, anthropomorphism. Firstly, I will suggest that a sentimental kind of anthropomorphism is challenged by the trainers' incorporation of the dog's alterity, or species-specific experience of the world, into their interpretations and actions. Then, I consider how the trainers' self-monitoring of their language points to their sense of ambivalence that surrounds anthropomorphism. In both discussions, I illustrate how the approach and techniques adopted by the trainers help to reassert a boundary between human and animal; that which is irrefutably challenged in practices of interspecies intersubjectivity.

Acknowledging the Dog's *Umwelt*

The first point I want to illustrate, with regards to the question of how anthropomorphism relates to the intersubjective practices conducted at my field sites, is the trainers' explicit recognition of the dogs' distinct mode of perceiving and engaging with the world. I observe that it is with this acknowledgment of species-specificity that the trainers approach their intersubjective practices with the dogs. This approach thus aligns the practices of my informants with a growing number of researchers who attempt to take seriously an animal's *umwelt* (Von Uexküll, 1957 [1934]), or 'self-world', as a way towards overcoming anthropocentrism (Hecht and Horowitz 2014).

In particular, given the nature of their work, the trainers are acutely aware that dogs experience the world largely through their olfactory system, to a much greater degree than the typical human. As a result of this understanding, when reading and interpreting the search behaviour of dogs, I have illustrated earlier in this thesis that the trainers focus especially on aspects of the dog's body that they understand to be associated with sniffing behaviour. Thus, as detailed in chapter 4, they not only pay attention to what they can *see* of the dog's body, but also what they can *hear*; particularly, the sounds produced by the dog's nose.

The trainers' recognition of the dog's distinct *umwelt*, and specifically an acknowledgement of the importance of the olfactory in the dog's engagement with his environment shapes how the trainers work during training. This is expressed by the trainers as a desire to 'think like a dog'; actively incorporating the dog's *umwelt* into their own perspectives and practices. I was myself encouraged to consider the dog's *umwelt* during a time at MDD when I was assisting Ed and Neil in Ellie's training. We were preparing for a session in which we would be teaching Ellie to detect her target odour outside of the training room and away from pots, stands, or the carousel; instead, the odour would be 'hidden' in or on random objects and surfaces. I had been offered the opportunity to pick the location of one of Ellie's 'hides' (in this case, a piece of gauze swab that has been 'soaked' in the training odour) and was told to choose somewhere along a corridor in the charity's main office. After tucking the gauze swab out of sight, on a wall behind the bottom corner of a poster, Ed instructed me to wipe my gloved-up hand indiscriminately along the wall and surroundings so that my own odour, and that of the glove, would not be concentrated around the hide and thus inadvertently direct Ellie straight to this area. Implicit in Ed's guidance is the notion that as a trainer I ought to 'think like a dog' by incorporating an appreciation of the dog's perspective into my actions, based on an acknowledgment of this animal's species-specific *umwelt* in which the olfactory largely dominates experience. Ed's comment is arguably illustrative of my informants' broader desire to become more like the dog in the process of training: an aspiration that, as aforementioned, is suggested to be increasingly emergent among contemporary dog-trainers (Wlodarczyk 2017, 40) who pay greater attention to the dog's emotions, acknowledge the dog's significant otherness, and recognize the dog as a sentient being (Pregowski 2015).

While the idea of 'thinking like a dog' underpins intersubjectivity on the part of the trainers in this context, it is with the related notion of 'becoming other', that takes place

during the occupancy of the *umwelts* of others, that Kohn (2007) considers the practices of transspecies intersubjectivity among the Runa. In particular, he notes that when an individual inhabits the different *umwelts* of others, 'attributes and dispositions become dislodged from the bodies that produce them and ontological boundaries become blurred' (Ibid., 7). As Kohn (Ibid.) explains, this 'transformative process of blurring' is a 'becoming' that carries significant risks for the Runa: 'dangers that emerge when ontological boundaries become excessively blurred'. For the Runa, the risk is 'becoming dog': a transformation they seek to avoid through the mobilization of communicative strategies. Whilst the Runa demonstrate the ability to know the dreams, intentions, and motivations of their dogs, afforded by their sense that beings of all kinds share a point of view[77], Kohn insists that the Runa do not wish to become dogs in the process of such transspecies interactions and communication. Echoing the Runa's aversion towards becoming dogs, Rane Willerslev (2004) notes how the Yukaghir elk hunters of northeastern Siberia use acts of 'mimesis' (Taussig 1993) in their 'attempt to assume the point of view of the animal, while in some profound sense remaining the same' (Willerslev 2004, 630). Such mimesis points here to the juncture of engagement and reflexivity, an experience of both difference and sameness, that is experienced by these hunters in their 'seduction' of the elk they hunt. Willerslev describes this as providing the hunters with a 'double perspective' (648).

[77] In his article '*How Dogs Dream'*, Kohn (2007) explains why the Runa interpret their own dreams in metaphorical terms, whilst interpreting those of their dogs—deciphered in their dog's sleep behaviours, for instance a bark or a twitching leg—literally. When the Runa dream, they see things from the perspective of the spirit masters of animals: hierarchically 'higher' beings than humans who conceptualize things in an alternate manner to humans. For instance, the animal masters see game animals as domestic animals and forest vegetation as planted gardens. Entering into the perspective of these powerful beings, and identifying a gap between their own mode of perception and that of the spirit masters, the Runa must interpret their dreams metaphorically in order to rectify their vision and make sense of it. Thus, for the Runa, metaphor guards against ontological blurring. Meanwhile, due to the shared mode of perception assumed among humans and dogs, and the dog's 'lower' hierarchical status vis-à-vis humans, the Runa interpret the dreams of their dogs literally. As Kohn puts it: 'In dog dream interpretation, the ontological gaps that are often assiduously respected collapse, at least for a moment, as dogs and people come together as part of a single affective field that transcends their boundaries as a species—an emergent and highly ephemeral self, distributed over two bodies' (17).

Among my trainer informants, commonalities can be observed between them, the Runa and the Yukaghir hunters, as they too navigate ontological boundaries in their interactions with the dogs. In particular, it can be observed that, like Willerslev's analysis of the Yukagir hunters, they also attempt to acquire a 'double perspective'. Making oneself sensitive to the umwelt of the dog is what enables the trainers to both successfully train dogs to become affected by certain odours and to interpret their dog's assessments of odours by deciphering their dog's behaviours. At the same time however, their primary perspective as humans is maintained, visible in the use of the screen that illustrates a physical and conceptual species distinction between dog and human. Thus, the trainers can be understood to apply a 'crucial brake' (Kohn 2007, 12) on perceived dangers of ontological blurring.

The fundamental separation between the life-worlds of human and dog is also explicitly acknowledged in the trainer's reflections of their work. For instance, as the team at MDD enjoyed a glass of champagne in the office to celebrate the end of a week of double-blind testing for a bacteria-detection project, Kelly looked down at Shadow who was sat on the floor—his gaze meeting hers—and mused:

> "I wish they knew what a good job they've done. I would just love to say to them how proud I am of them. I wish they knew the enormity of what they've done. You have no idea, do you? You just want me to put my hand in my treat pouch."

Certainly then, whilst holding an empathetic stance towards the dogs and routinely highlighting the porousness of the boundary between human and dog as they develop intersubjective relations, the trainers maintain a recognition that significant points of difference persist between the *umwelt* of human and dog. At the same time however, the trainers also recognize that there are fundamental aspects of the world that are accessible to beings of both human- and dog-kind that make it possible to develop intersubjective practices towards an idea of what it *might* be like to be a dog. This is notable in the language used by my informants to interpret their dogs' behaviour. For example, reflecting on the performance of a dog he had worked with earlier in the day, Simon at MDD explained to me that Rolo had been sniffing samples of a training odour that had come in from a new supply and that he had demonstrated difficulty in recognizing this odour as his target. In short, although the odour was, in theory, the same, the new supply has been processed at a different place and by novel people, in comparison to the training odour

Rolo had been used to detecting over the past few years of his career at MDD. Thinking about the impact this might have on the specific composition of Rolo's target odour, and thus Rolo's difficulty in recognizing this odour as a continuation of his target odour, Simon told me, "You can get an idea of what the dog is processing." In his comment, rather than claiming to know with total certainty what Rolo was experiencing, Simon expresses an empathetic understanding of Rolo's engagement with the odour, based on what is known about the dog's species-specific olfactory capability that enables him to detect minute differences between odours.

I also suggest that Simon's approach towards interpreting Rolo's behaviour reflects the aforementioned impulse shared among the trainers for the dog to 'tell you'—about the odours they are smelling, or the emotional state they are feeling—rather than simply projecting pre-determined assumptions onto the dog. Inevitably, the trainer 'speaks for' the dog, but by creating space for the dog to 'speak back' in training encounters as I have argued, the dog is himself able to exert agency in this process.

By taking the dog's distinct *umwelt* into consideration, as they endeavour to engage intersubjectively with the dogs, the trainers' interpretations arguably account for what they consider to be most meaningful or important to the dog—rather than the human—as he searches. Thus, they work towards an understanding of the dog that is less exclusively anthropocentric than strict, or 'sentimental', anthropomorphism (Pregowski 2015) and arguably one that reflects more faithfully the dog's experience of the world: a stance more aligned with an approach of 'critical anthropomorphism' (Morton et al. 1990).

Whilst I have noted that the trainers maintain a distinction between human and dog, the empathy that they express towards the dogs during training sessions illustrates an understanding that particular aspects of the world are generally available to beings of both species. Thus, while they acknowledge that humans cannot smell with the same sensitivity as dogs, they do know what it is like to smell. This recognition enables a sense of animality that traverses the human/animal divide and affords them with a perspective from which they can empathize with dogs. Here, Maurice Merleau-Ponty's (1964) concept of 'strange-kinship' provides a useful framework. Significantly, strange kinship permits the recognition of differences between the specific content of animal and dog worlds, while maintaining the species' shared grounding. As Merleau-Ponty (1995, 176) insists, 'there is no break between the planned animal, the animal that plans, and the animal without plan'. Applying the notion of strange kinship in her analysis of the relationships between scientists and laboratory rats, Dennis (2014) notes that this term evokes 'the sense in which

the world is shared among and generally available to the species, despite their evident differences in the fleshiness of their being' (46-47). Thus, whilst enabling the acknowledgment of species differences, strange kinship does not propose an understanding of relations of the human to the animal in terms of hierarchy.

Ambivalence Around Anthropomorphic Language

Although speaking for dogs in supposedly anthropomorphic terms is arguably inevitable, my trainer informants expressed an ambivalence about their self-identified anthropomorphic language. In order to manage this ambivalence, when speaking about and 'speaking for' the dogs, my informants adhere to an informal kind of 'self-policing' (Candea 2013b, 424) in relation to the vocabulary of supposedly human-like qualities and feelings. This is another strategy through which a 'crucial brake' (Kohn 2007, 12) is imposed in order to reaffirm ontological separation.

Aware that the language they use to describe the dogs might be considered anthropomorphic, and mindful of the largely negative, 'unscientific' connotations of such language, I often observed the trainers catch themselves and reflect on their vocabulary and the constraint they feel about the difficulty of speaking for the dogs in nonhumanist terms. For instance, discussing with me the differences in personalities between the different dogs at the PVWDC, Sue commented that "some dogs come to us a little nervous, a little worried or uncomfortable, or anxious if we're gonna—I mean, they're kind of behavioural words of humans but I don't have any other ones." Here, Sue is ambivalent about her dependence on descriptive terms that she considers largely the domain of humans, expressing an element of concern in extending such expressions to describe the dogs; an apprehension that emerges because, in her articulation of the 'personalities' of dogs, Sue is navigating the boundary between human and animal. Indeed, the extension of personalities beyond humans to nonhumans, is still a relatively recent phenomenon and while gaining growing credibility among animal behaviour scientists (Gosling 2008), older trainers like Sue (who is in her sixties) have been involved in dog-training for decades before such understandings were thought possible. Thus, encultured in a tradition of dog-training that perceived the boundary between human and dog as more rigid than is widely considered today, Sue maintains a cautious attitude regarding the risks of slipping between the categories of human and animal.

At other times, my informants' concerns about how to speak about and for dogs were more explicitly associated with anthropomorphism, as in Jenna's comment during an

interview: “You know, it’s hard because I could put all these emotions on a dog, like I could anthropomorphize everything. Is that the right word?” Whilst pointing to the inevitability of speaking for dogs in supposedly humanist, or anthropomorphic terms, Sue and Jenna acknowledge an implicit understanding that they ought to remain attentive to a distinction between human and dog.

Whilst my informants were apprehensive about speaking about and for the dogs in explicitly anthropomorphic terms, I follow Kay Milton’s (2005) suggestion that in many situations that are commonly referred to as ‘anthropomorphic,’ no particularly good grounds exist for assuming that the human who is attributing certain characteristics to an animal is doing so with any reference to humanity or animality. Such cases, Milton urges, should more properly be termed ‘egomorphism’: a concept that ‘implies that I understand my cat, or a humpback whale, or my human friends, on the basis of my perception that they are ‘like me’ rather than ‘humanlike’’ (Ibid., 259). In other words, egomorphism refers to the notion that ‘I see something of me in you’, rather than equating a dog with a human per se.

In the following vignette, of a training encounter between Simon and prostate-cancer detection dog Jess, Milton’s egomorphism might more aptly account for Simon’s interpretation, rather than anthropomorphism as he proposes.

Before tasking Jess to search, Simon tells me that the target in this lineup, a urine sample from a prostate cancer patient, is ‘weaker’[78] *than the sample that she alerted to in the previous run. I ask Simon if that means he is anticipating that Jess might have difficulty identifying it. He nods his head to confirm my assumption. Consecutively searching the samples around the carousel, Jess hesitates on the target in position 3, pausing her nose over the pot for a second before moving past it.*

> *Simon: “I should’ve clicked that [i.e., to reinforce Jess’s odour recognition: to help her by offering an early click to tell her this is the target, as Simon believes*

[78] The notion of target samples as being described on a continuum of strength is based on factors related to the specific disease details of each individual, such as the patient’s tumour size and Gleason score measure, as detailed in the laboratory report that accompanies each sample provided to MDD by the hospital that the charity is working in collaboration with.

this is a weaker sample]. I wasn't quick enough. And now she'll pick 5." [5 is a control sample that contains other non-cancerous disease markers]

As Simon predicts, Jess false indicates on sample 5 before quickly getting up and moving on to search the rest of the samples on the carousel.

Simon: "Now she's really thinking about it, if you can anthropomorphize it. She's interrogating. It's like if you were driving to work and the normal road you take every day was blocked and you had to go another way. You know the way but you have to think about it more."

Explicating his interpretation, Simon ponders over his attribution of mindedness to Jess: "if you can anthropomorphize it." He then continues to articulate how he perceives Jess's situation, by way of analogy to a specifically human experience. Significantly, I note, he precedes this comparison with the comment "It's like", suggesting that he acknowledges the alterity that makes distinct Jess's experience from the analogous circumstance he then describes. Rather than attributing qualities to Jess that he considers to be explicitly 'human'-like, Simon's intersubjective endeavors reflect more closely his perception that, like him, the dogs too can experience a state of uncertainty, demanding greater concentration, when the aspects of their environment they have come to take for granted change unexpectedly.

To conclude this assessment of anthropomorphism among my informants, I suggest that the trainers' particular practices of intersubjectivity begins to turn the notion of anthropomorphism on its head. Rather than an attempt to simply project human-like experience onto the dog, their interpretations and practices reflect their desire to adopt a more dog-like perspective of the world. Whilst this could still arguably prompt critiques in keeping with Nagel's (1974) argument about the impossibility of knowing the world from the perspective of another species, I note that the trainers actively maintain a recognition of the species differences that prevent them from fully adopting a canine perspective, whilst simultaneously acknowledging a shared sense of animality between humans and dogs that enables human–dog intersubjectivity.

iv. Conclusion

In this chapter, I have explored how trainers produce interpretations and representations about the dogs. In order to interpret the performances of the dogs with whom they work, I have illustrated that it is not enough for trainers to simply have a knowledge of the behaviour of dogs as a sum species. Rather, they are required to constantly read the individual dog's body language, to develop an embodied knowledge of the minutiae of each dog's trained response in order to ascertain whether the dog is certain in his decision. This specific mode of human–dog relating is what enabled Ed to know not to call 'indication' when Lola raised her paw, to return to the example presented at the beginning of this chapter. Thus, a notion of producing 'good' bio-detection dogs, proficient trainers and data in this context can be considered the ability of the human–dog dyad to mutually generate interpretations that evade uncertainty.

The analysis presented in this chapter illustrates that the knowledge produced in bio-detection dog research emerges neither from the dog or human considered as isolated entities, but from the interface of their relationship. I have illustrated that what is being studied by my informants is a combination of: (1) a dog's ability to detect an odour, (2) his ability to communicate the presence or absence of a salient odour to his trainer and (3) his trainer's ability to interpret the dog's signals. Therefore, the data and subsequent knowledge that is produced in this field, is clearly neither 'without us' [the humans] (Despret 2004, 131), nor without the dog. As a result, both partners are revealed to be necessarily response-able agents in the process of knowledge production.

Furthermore, I have identified multiple representations of the bio-detection dog as emergent in the process of knowledge production. They are, on the one hand, represented as statistical units or akin to mechanical devices, whilst at the same time there remains a recognition that, unlike automata, the dogs require extensive training and care that responds to the needs and desires of each individual. Even when written traces afford the representation of the dog in terms of statistical units, the dog as a naturalistic animal—in the flesh, not merely in its depictions—is maintained throughout the processes that render him into a being *with* whom scientific knowledge is made available.

Rather than excessively projecting human characteristics and motivations onto the dog, I have argued that human–dog attunement, with an emphasis on the dog's capacity to respond and an attention to somatic sensibilities, enables the dog to become an agent who

can ‘tell’ you how to interpret his behaviour. Whilst this nevertheless persists as an inevitable case of a human speaking for an animal, my argument has emphasized the active role played by the dog himself in shaping the human’s interpretation and subsequent action. Thus, in keeping with contemporary approaches to dog-training philosophy outlined in chapter 4, whereby the dog’s perspective is considered both attainable and important in guiding their trainer’s actions, I have illustrated how the trainers seek to incorporate something of the dog’s perspective into their interpretations.

Here it can be observed that the trainer-come-researchers adopt an orientation towards their study of the dogs that is, in a significant way, in keeping with the approach employed by primatologist Shirley Strum (1987, 30) when working with baboons. As Strum explains, ‘I tried to let the baboons themselves ‘tell’ me what was important’. However, although overlaps are observable, between the interspecies relationships between trainers and bio-detection dogs and those such as Strum’s (Ibid.) and also Smuts’ (2001) with the respective groups of baboons they study, the human–dog relationships among my informants also stand in distinction from these other cases of interspecies relations in scientific practice. This is because I have illustrated that in order to produce the scientific data of bio-detection dog research, the trainers and dogs must work interdependently towards a shared goal.

Chapter 8. Conclusion

Whilst dogs are born with an exceptional olfactory system, this thesis has illustrated that recognizing a distinct target odour and offering a clear and consistent bodily indication in response to this odour are learned skills that are honed over many months of training. Through insights developed during twelve months of ethnographic fieldwork, this thesis has explored the practices of training through which bio-detection dogs and knowledge about their olfactory capabilities, are produced, suggesting that practices of bio-detection dog research fundamentally depend on affective human–dog partnerships.

The discussions presented in this thesis have illustrated the interdependency of the relations between human and dog in the context of bio-detection research, prompting an understanding of these human–dog relations as 'mutually affective' (Latimer and Miele 2013, 5) rather than exclusively human dominated or asymmetric. Through the training practices in which the human and dog become attuned to the body of the other, the dyad become together something novel: a proficient trainer and bio-detection dog team, shown to elicit data and produce knowledge collaboratively. Indeed, I have argued that the dog-trainer cannot become proficient in his skill without the bio-detection dog and, simultaneously, the bio-detection dog cannot learn his task or job without the trainer. Combined, they form not only a satisfactory but, a 'productive and thriving partnership' (Licklider 1960, 75).[79] Thus, this thesis has illustrated that the detection in this context is dependent not solely on the spontaneous actions of the dog but on the highly formalized meeting of a 'collective body' (Winance 2006), constituted of not only the human and dog, but also the samples, training equipment and rewards that, combined, facilitate this work. Though the human and dog both work independently, each is also implied and transformed in the process.

Responding to the research questions I set out to explore in this thesis, I note the emergence of two key themes in particular. Firstly, I have demonstrated that throughout the processes by which both bio-detection dogs and knowledge are produced in this area of scientific enquiry, the dogs' capacity to respond is accommodated and recognized as an essential element of the human–dog dyad. Secondly, these practices have been revealed to be

[79] Licklider uses this description to refer to the relation of interdependency between the fig tree and insect.

characterized by the navigation of various categorical boundaries. Whilst these two themes overlap, for clarity I discuss them below in succession, as I clarify the main points developed in this thesis and their implications in relation to the existing literature.

The Mutual Constitution of Knowledge and Nonhuman Agency

This thesis has illustrated that the success of bio-detection dog training and testing is entangled with the capacity of a body to encounter the affects of another body, with this affective dimension of bio-detection dog-training constituting both human and dog. In the process of training and testing, I have demonstrated the significance of the agency of the dogs and, in particular, their capacity to respond and be responded to accordingly. By employing training and testing methods that eschew force, in order to 'recruit' and train canine research subjects, the dog's 'active cooperation' (Haraway 2008, 55) is shown to be acquired and, furthermore, required. In this process, attention is focused on somatic sensibilities, permitting the dog the capacity to 'speak back', shaping the material reality of the environment. By illustrating how the dogs affect their trainers, for instance, trainers altering the speed of their movements in response to the tempo of a dog, or arranging the composition of search samples in response to a dog's search performance, I have followed Despret (2004) in suggesting that the dogs can be considered as themselves training the humans how to respond; 'proposing new ways to behave' (122).

Throughout this thesis, Haraway's (2008) notion of 'response-ability' has proved a useful concept with which to understand the relationships between trainer and bio-detection dog. The analysis developed here suggests, however, that not only is it possible for dogs to respond to and reshape their environment, but that this kind of interspecies response-ability is fundamentally imperative to the production of 'good' relationships between researchers and research subjects, and, consequently, the production of 'good' scientific knowledge, based on interpretations that lack ambiguity. These findings are in keeping with the literature concerning animal-dependent scientific practices that have emphasized the significance of care practices in ensuring a more nuanced understanding of the needs of one's research subjects (e.g., Davies 2012; Greenhough and Roe 2011).

Thus, in response to my research question, 'how ought we theorize the role of bio-detection dogs?', the analysis presented in this thesis makes clear that it would be a mistake to consider these dogs as 'mere instruments or objects of labour' (Clark 2014, 159). Whilst the dog's behaviour is clearly shaped by formalized training practices and techniques, in

the process, their individuality is not reduced in the same way as it is in the laboratory or slaughterhouse. Instead, the unique qualities of each dog are significant and shape both their own actions and those of their human caretakers.

Thus, furthermore, whilst I have emphasized the mutual constitution of trainer and bio-detection dog, it is important to acknowledge that the dog's agency ought not to be considered exclusively in relation to the humans with whom they work. My analysis has demonstrated that these dogs also have an agency that is related to their qualities as individuals: a finding that is consistent with Nelson's (2017) historical study of canine agency in the Soviet space flight programme, in which she argues that the dogs were 'not interchangeable or generic' (Ibid., 90).

Navigating Boundaries

An additional theme to emerge from the analysis presented in this thesis is the ongoing navigation of boundaries: in particular, the boundary between human and animal that is often assumed to be rigid in western culture. In the performance of bio-detection dog-training and research practices, where ambivalences and uncertainties are prevalent, this boundary is illustrated to be both reaffirmed and challenged.

A fundamental finding of this thesis is that the process of training bio-detection dogs has been revealed to be informed by a degree of uncertainty and ambivalence. In particular, I have illustrated how working with an ambivalent odour heightens the trainers' sense of obligation to becoming attuned to the dog. In becoming attuned however, another ambivalence is brought to the fore, as trainers navigate the possibility of knowing an animal's mind whilst also acknowledging the dog's species-specific capabilities and *umwelt* (von Uexkull 1957 [1934]).

Rather than consider the development of an understanding of the mind of the individual dog an impossibility, my informants' practices illustrate the permeability of the purported species barrier between human and animal, as they routinely interpret the actions of their dogs. In particular, I have shown that the practices of bio-detection dog-training and knowledge production are achieved with a focus on nonverbal communication. In chapter 4, I illustrated how, through training, human and dog learn how to become attuned with each other, or to affect each other, through attention to the somatic; reading or 'listening' to the other's body. By becoming attuned to the dogs, through response-able methods of training, the trainers are able to, at least partially, access a part of the world

that they are generally unable to experience due to their physiological limitations. In the process, the dog's nose becomes more than just a part of the dog's body—an instrument used by the dog himself to navigate the world and conduct his work—but also a body part that becomes an extension of the people who are tasking the dogs with this specific work. Thus, the assumed limitations of the human body—in terms of its perceptual capacities—is an additional boundary that is challenged in this work. I have suggested, therefore that bio-detection dogs can be considered as 'mediators' (Pemberton 2013, 74) of particular kinds of knowledge about the world that are generally elusive to humans. This understanding of the role of the dogs is consistent with Kohn's (2007), in his analysis of the Runa practices of talking with dogs, whereby dogs are transformed into shamans through a process of hallucinogen consumption. Moreover, across the globe, dogs routinely penetrate human life, mediate between worlds and call into question the boundary between human and animal.

Whilst the porousness of the species barrier is rendered visible, as human and dog are shown to be 'co-conversationalists' (Bolton and Degnen 2010, 11) in the production of knowledge that is not only about dogs but fundamentally produced *with* them, this thesis has also recognized the trainers' simultaneous insistence on a distinction between human and dog, with particular regard for the dog's distinct olfactory capabilities and their species-specific umwelts. In chapter 7, I proposed that this recognition of the dog's species-specific mode of engagement with the world—and attempts to incorporate the dogs' alterity into training practices—provides a challenge to a simplistic analysis of the trainer's intersubjective practice of 'speaking for' (Sanders 1999) as mere anthropomorphism.

At the same time however, I have shown that the understanding of species difference advanced by my trainer informants, exists alongside a recognition of a fundamental shared animality that promotes the possibility of mutually constituted human-dog meaning making. In other words, whilst it is recognized that the dog is superiorly endowed in his olfactory capability relative to [hu]man, it is simultaneously acknowledged that both human and dog share the capacity of a sense of smell; thus, promoting the development of empathetic relations between the species.

These findings, that emphasize both the preservation of species division and the dissolving of such boundaries, are in keeping with Latimer's (2013) concept of the state of 'being alongside', as a notion with which to think through human–animal relations. Latimer's work in developing this concept especially complements the analysis presented

here, for she highlights the 'significant otherness' of human–animal relations 'in terms of interspecies socialities and interdependencies' (90).

The practice of training dogs to detect the odour of human disease has been informed by several changes in approaches to dog-training and scientific understandings of animals and the scope of their roles in scientific research: historical and cultural shifts that have been traced in this thesis. Today, among an increasing majority of dog–trainers, the relationship between human and dog is no longer considered in terms of master-servant, but instead as a partnership in which each partner guides the other towards the mutually successful completion of a task. This shift is arguably related to recent developments in the scientific field of ethology that have led to an increasing recognition of many kinds of animals as sentient beings, with greater self-awareness and consciousness than had been possible to assume with an approach dominated by human exceptionalism: developments that have prompted the emergence of new perceptions among scientists with regards to their relations with the animals they study.

However, the practice of enrolling bio-detection dogs in scientific study, as analyzed here, nevertheless presents challenges to the boundaries that constitute traditional scientific practice, whereby research animals are typically distinct from the pets living within human homes. In the context of bio-detection dog research, this boundary is dissolved, as the research subjects in this case navigate multiple subjectivities including research subject, worker and pet. The category of 'research animal' thus becomes blurred. While scholars (e.g., Birke et al. 2004) have certainly noted the ability of a multitude of animals in scientific practice to respond to their conditions and treatment, thus shaping the material reality of events, the kinds of choices bio-detection dogs are permitted to help make—with regards to their desire to participate in the first instance, or their career speciality—demonstrably set these animals apart from those of conventional scientific practice.

Taken together, my findings illustrate, through the lens of a previously unexplored space of animal-dependent research, the possibility for relations to exist between humans and animals that are not based on human domination and animal subservience: thus, this work is in keeping with recent scholarship on the notion of 'posthuman communities' (Cudworth 2017). In advancing such an argument, I do not refute the asymmetric power relations between human and dog that are inevitable given the consequence of the dog's

incorporation into the home as dependents (Charles 2016). However, what is illustrated by my analysis is the possibility to recognize the porousness of the assumed human/animal barrier and the mutually affective relations that can emerge—even in the supposedly rigid contexts of scientific practice. Understanding how the spaces and practices of animal-dependent research are tied to the animal's flourishing is not only of scholarly interest but is vital for policymakers, scientists and animal caretakers in taking action to improve animal welfare in these contexts.

Limitations and Recommendations for Future Research

The scope of the analysis presented in this thesis was restricted by data protection regulations that prohibited my access to the population of people who donate samples for the training and research of bio-detection dogs. If the practice of using bio-detection dogs to detect human disease should move beyond the field of research and become operational as an adjunct in the diagnostic process it will be especially important to understand how this practice is understood and engaged with by the patients implicated.

Another way in which this study is limited is with regards to the restricted amount of data obtained concerning the lives of the dogs outside the training and research facilities. More data concerning the dogs' 'home' lives would strengthen the insights generated in this thesis by contributing to a fuller understanding of these dog's everyday lives.

Several other avenues of further research associated with this study can be identified. Firstly, it would be useful to conduct an examination of the potentially shifting shape of trainer–dog relationships in the arena of bio-detection as the technology in this field evolves. Already, a prototype sensor has been developed by experts in animal-computer interaction that is able to record and graphically represent the nuances of a dog's responses (Mancini et al. 2015). Mancini and colleagues (Ibid.) found that dogs spent longer investigating positive rather than negative samples and that they placed greater pressure on the plate when sniffing a positive sample compared to a negative. Technologies such as this render visible the nuances of the dog's responses that are often invisible to even the experienced handler's naked eye. If this technology becomes operational there may be implications for the shape of human–dog interconnectedness, as the dependency on human interpretation would, at least partly, shift from interpretation focused on the individual dog's movements, to the interpretation of computer-generated representations.

A final area that might be productive for future investigation is the ethnographic exploration of a context in which a different species is being trained in disease detection. For instance, in Tanzania, African pouched rats are being trained to detect the odour of tuberculosis.[80] Human relationships to rats are profoundly ambiguous (Birke 2012), with rats considered, at various times, either 'pests, pets or paragons of biomedical research' (4). Understanding how this animal is perceived and treated in the context of disease detection would provide a fruitful comparison to the work presented here and highlight cultural and species-specific aspects of these practices.

[80] The charity *APOPO* trains rats to detect tuberculosis in human sputum samples. See https://www.apopo.org/en

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