Rethinking the Relationship Between Skill and Technology: Bringing Archery into Conversation with Cybernetics and Postphenomenology.

Submitted by Eliott Rooke, to the University of Exeter as a thesis for the degree of Doctor of Philosophy in Human Geography in January 2021.

I certify that all material in this thesis which is not my own work has been identified and that any material that has previously been submitted and approved for the award of a degreed by this or any other University has been acknowledged.

Abstract

This thesis seeks to better understand human-technology relations in skilled practice by exploring how archers view their relationship with their bows. I draw on the post(-)phenomenological literatures of philosophy of technology (Ihde, 1993) and geography (Lea, 2020; 2009b) to understand archery as a more-than-human practice and, by bringing it into conversation with 1950s cybernetics, develop a language to discuss how communication occurs across more-than-human systems. This approach enables me to avoid privileging humans or anthropomorphising technology, traits I identify as common in contemporary debates surrounding so-called 'prosthetic' technologies which present technologies as being 'incorporated' into human bodies by becoming 'transparent.'

I ground these discussions through my empirical data, primarily collected through a year-long ethnography conducted at Exeter University Archery Club, where I was able to observe and participate in the kinds of relationships formed through the intimate engagements archery requires. Subsequent interviews were used to expand on participants' experiences of the sport to emphasise the thesis' focus on the *felt* relationship.

Through an exploration of affect and atmospheres, I argue that disruptions to practices can be interpreted as interference in more-than-human communication, I further suggest that controlled exposure to these circumstances can be beneficial for skill development. Through this emphasis on communication, I propose an alternative approach to the incorporation-centred methods in the literature. My 'companionship' approach draws on contemporary materialist literature (e.g., Barratt, 2010) to seek to identify parity between all actors in human-technology relations while also recognising the significant differences in how agency is expressed. The companionship approach that I identify locates skill in the communication between actors of the more-than-human system, and present new opportunities to understand skilled performance and design, which I demonstrate through a practical piece in which I revisit and re-design pieces of my archery equipment.

Acknowledgements

Thank you to my supervisors, Jen Lea and John Wylie, whose tireless support has been vital to this thesis, and to the staff of the University of Exeter geography department, for all they have taught me these past eight years.

This work would not have been possible without the financial support of the Economic and Social Research Council, who also provided further opportunities in the form of an internship project looking at artificial intelligence which helped me rethink the broader applications of my research.

Thanks to my family for all their support throughout the course of this project and to Lizzie, who has helped me in more ways than I could list.

I am grateful to have been a part of a strong PhD community at Exeter and beyond, particular thanks must go to Charlie, Maria, Surabhi, Alex, and Joshua who have each brought fresh perspectives to my work.

Thanks to all of my participants at Exeter University Archery Club, in particular Rachael, who played an essential role in setting up the project; Aisha, my most enthusiastic and sarcastic reviewer; and Alex, Dan, and Val, whose engagement with my work motivated me through some of the toughest points.

A special thanks must be given to the staff at Holland Hall reception for their moral and logistical support, without which it would not have been possible to continue working throughout the pandemic.

I would also like to thank the Residence Life Team who provided me a home throughout my studies.

There are no doubt many other people that were essential to the completion of this project that I haven't listed here. Whether it was a brief conversation at a conference, a helpful tip on Twitter or the perfect paper for the moment, thank you all.

Contents

Table of Figures

Equipment Glossary

Bow and Riser

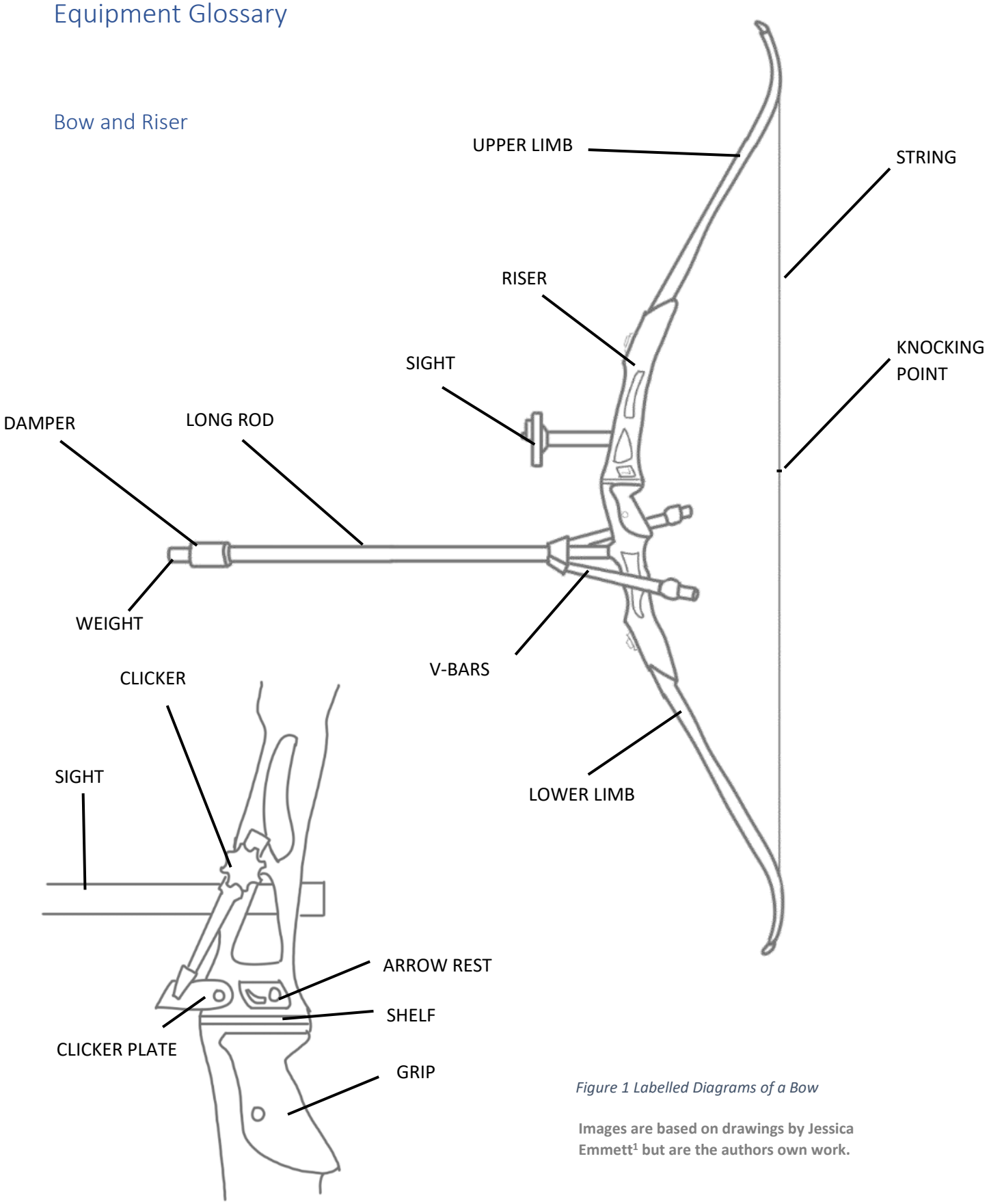


Figure 1 Labelled Diagrams of a Bow

Images are based on drawings by Jessica Emmett[1] but are the authors own work.

[1] For the originals, see http://www.jessica-emmett.com/blog/archery-beginners-recurve-diagrams/

Arrow and Rest

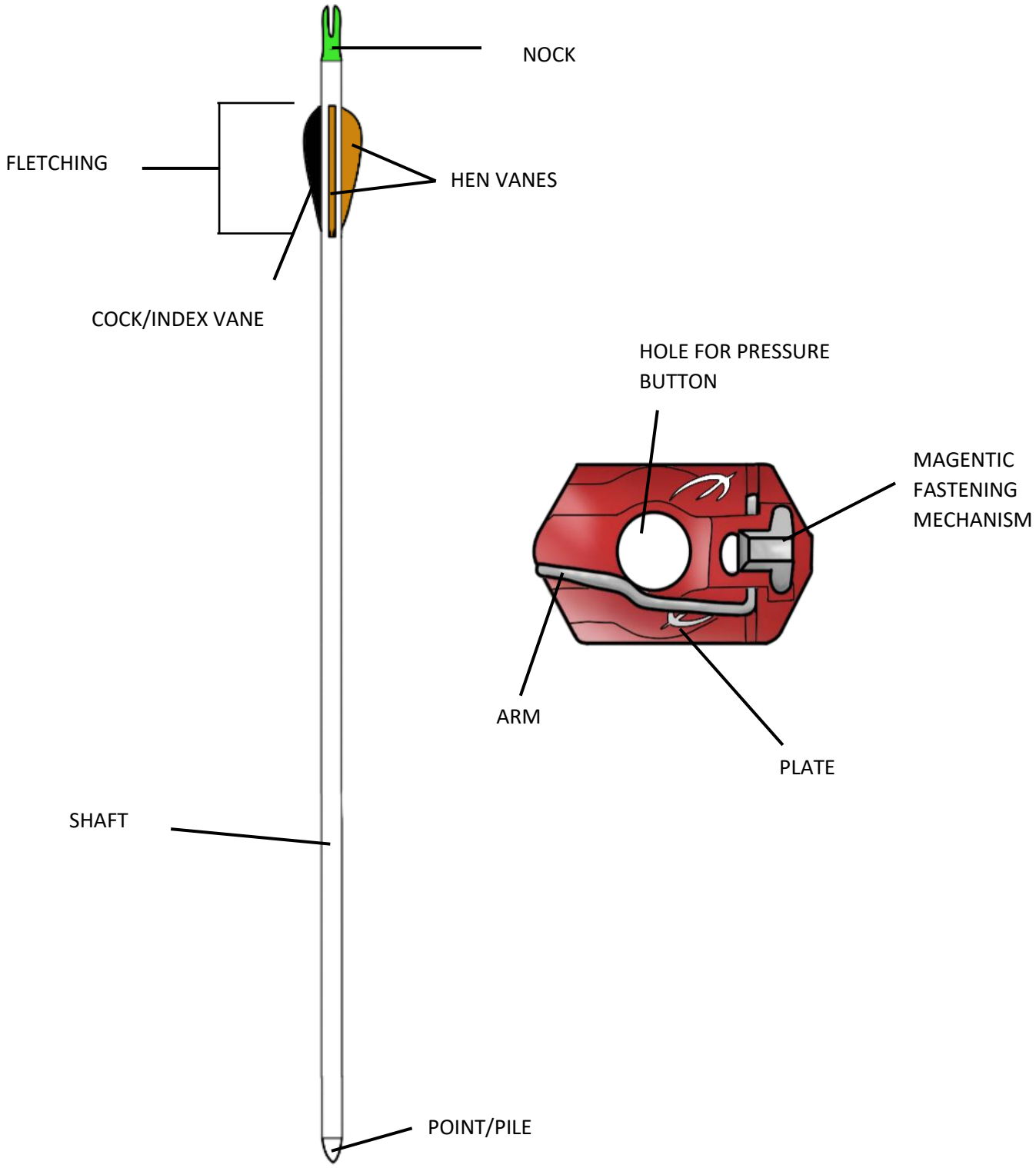


Figure 2 Labelled Diagram of Arrow and Arrow Rest

Sight

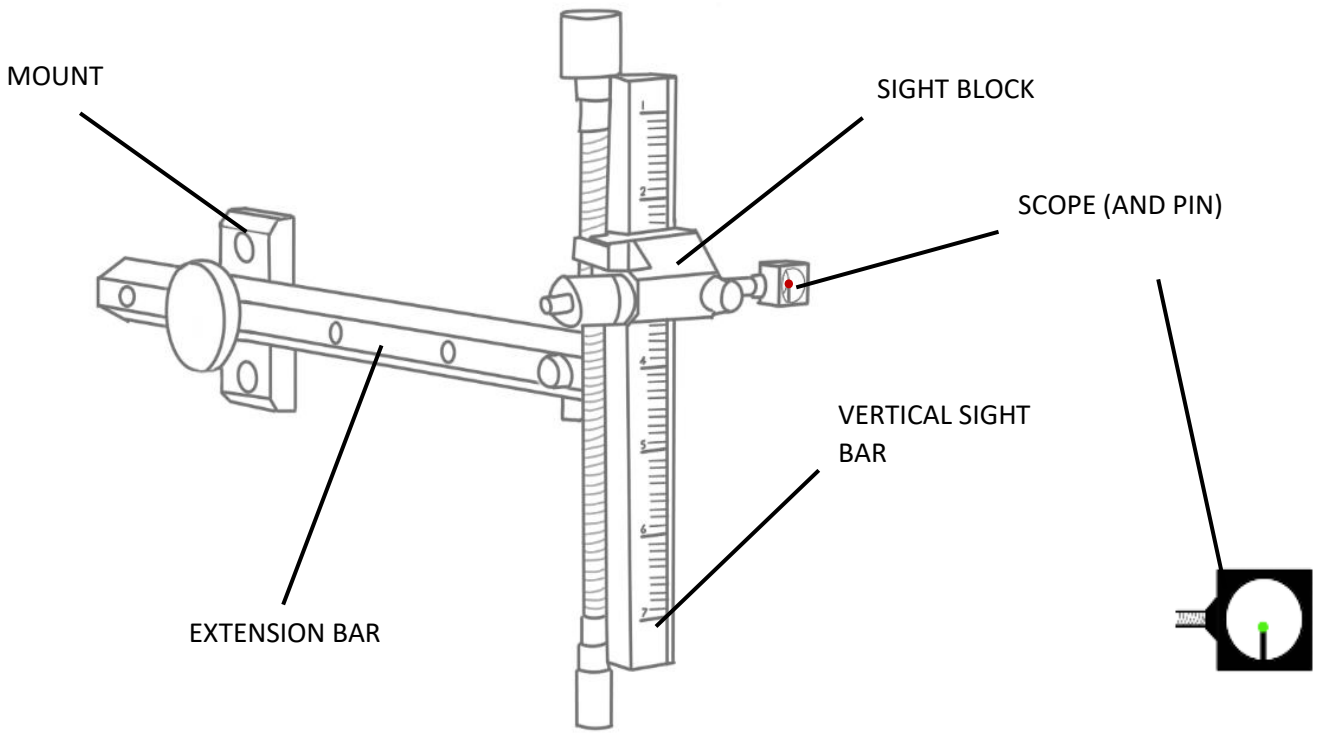


Figure 3 Labelled Diagram of a Sight

Glossary

Arm (arrow rest) – A thin bit of plastic that the shaft of the arrow rests on

Arrow Rest – A mechanism attached to the riser to hold the arrow

Clicker – A piece of metal or plastic that sits over the arrow when it's on the rest. As the arrow is draw backwards it slips over the tip of the arrow and hits the clicker plate making an audible 'click' to indicate that arrow has been drawn to its full length. Clickers need to be tuned to the length of the arrow and archer's draw length.

Damper – A rubber shock absorber situated between the long rod and weight. Not all archers using a long rod will have a damper.

Extension Bar – Connects the sight to the riser of the bow. Moves the sight closer to, or further from, the riser which can be used to make larger adjustments to the sight mark (most common when changing from indoor to outdoor distances).

Fletching – The stabilising mechanism of the arrow. Usually, plastic vanes or feathers. Competitions usually require two colours to aid identification when scoring. Arrows are normally placed equidistant around the shaft. The index/cock fletching will be parallel to the rest and perpendicular to the string when placed on the bow.

Grip – The part of the riser that is held. Usually wood or plastic.

Limb – The flexible part of the bow that transfers energy from the archer to the arrow. Usually made from a combination of carbon fibre, wood, and foam.

Long Rod – A stabilising mechanism which shifts the bow's centre of gravity forward to stop it 'kicking back' when an arrow is released.

Magnetic Fastening Mechanism – A hinge which allows the rest to be forced back against the plate when an arrow is released to reduce friction. It then resets itself afterwards.

Mount – The mechanism for attaching a sight to the riser.

Nock – The part of the arrow which clips onto the string. Made of plastic.

Nocking Point – A marker on the bow to indicate where the arrow goes. Normally a single brass disk or loop of string which the nock of the arrow is placed under, however some archers may use two and place the arrow in between.

Plate – The base of the arrow rest. Attaches to the riser. Normally made of plastic or metal.

Point/Pile – The tip of the arrow. Unlike hunting arrows, the points of competition arrows are mostly rounded as they do not need to penetrate far into the target. Cheaper arrows will usually be more pointed as they travel slower, high quality arrows made from aluminium/carbon composite are entirely rounded.

Pressure Button (hole) – The pressure button is a spring mechanism which applies force to the arrow to counteract the flexibility of the shaft. It threads through a hole in the riser and arrow rest.

Riser – The centre part of the bow which is held. Generally made of wood or metal.

Scope (and pin) – The part of the sight archers aim through. The pin is centred over the target. Magnifying scopes are generally not permitted for competitions.

Shaft – The main body of an arrow.

Shelf – A ridge in the riser. In traditional archery (e.g. flatbow) the arrow is placed here. This is known as "shooting off the shelf" and is generally inaccurate due to the high levels of contact and therefore friction. Modern bows use an arrow rest which holds the arrow just above the shelf.

Sight Block – The main body of the sight. It can be moved left and right to establish a horizontal sight mark.

String – Made of synthetic materials woven together (called 'strands'). A typical string may consist of 14-20 strands of one or two colours, but typically just white. Some archers pay more for custom-coloured strings.

V-bars – Additional stabilisers which go round the sides of the bow. The two tips of the V shape are individual rods called short rods. V-bars are usually only used by experienced competitive archers as the would convey little benefit except to those already performing highly.

Vertical Sight Bar – A bar which the sight block moves up and down. It is marked with increments to measure the vertical sight mark.

Weight – Part of a stabilising mechanism which shifts the bow's centre of gravity forwards.

EUAC Committee Structure

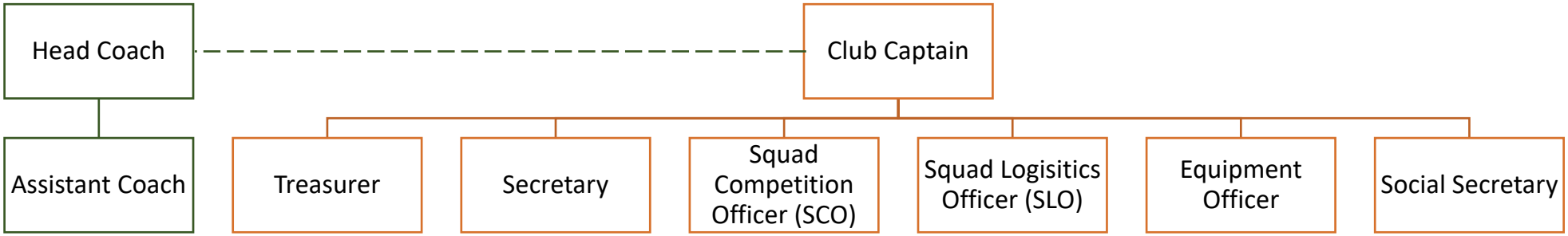


Figure 4 Committee Structure

The committee positions (orange) are elected to their roles by a popular vote of the club. The coaching team (green), which contains a variable number of assistant coaches, is appointed by the committee. The exact relative positions of the head coach and the committee was unclear and could vary from year to year, it appeared to be largely dependent on their competence in the role and the respect they garnered as a result.

"If you trace the history of mankind, our evolution has been mediated by technology, and without technology it's not really obvious where we would be… we have always been cyborgs in this sense."

(Evgeny Morozov, *Are We Becoming Cyborgs?*)

1. Prologue

As humans, our lives are continuously and inescapably entangled with those of the technologies we live alongside. For some who have studied this entanglement, our relationship with technology is a defining characteristic of being human (Clark, 2008; Taylor, 2010; Hayler, 2015). We are, increasingly, technologized human beings – beings which co-evolve with technology (McLuhan, 1964: 56), and for whom technology "is at least as critical to our identity as our soft tissues." (Taylor, 2010: 189). Technology, as these theorists understand it, is a "human activity" (Hayler, 2011: 40). This is an understanding fraught with implications and complications, not least that humans are not the only species to develop and use technology, but one which nonetheless remains influential and permeates an extensive array of disciplines. This thesis strives to understand how our relationships with technologies take shape, and in doing so provides technology with the opportunity for independence from such anthropocentric definitions. As this thesis will proceed to demonstrate, technology is far more than just a 'human activity'. Rather, it is something with the ability to exert its own will, to transform the world around it, and to create and engage in meaningful relationships with living things.

This thesis responds to three prompts. The first is to attend to a world of technologized beings; in the words of novelist J.G. Ballard: "science and technology multiply around us. To an increasing extent they dictate the languages in which we speak and think. Either we use those languages, or we remain mute." (1975: 49). Yet, at times our grasp of this language falls short, and the lack of a unified approach does little more than further obfuscate discussion and erect – or reinforce – disciplinary boundaries. Taking inspiration from Ballard's claim, this thesis intends to mobilise key terms and theories to produce a language with which we can speak about emotion, affect, and experience in more-than-human systems. By drawing on cybernetics and postphenomenology this thesis will demonstrate ways in which these experiences can be located "trans-humanly" (Lea, 2009b).

The second prompt stems from the ESRC's strategic priority on 'How and Why Behaviour Changes'. Which calls for research on the role of technology in behaviour change. This thesis attends to this prompt by exploring the ways in which technologies frame choice and behaviour through the very dictation Ballard described above. It aims to develop an understanding of how technologies can afford

new possibilities for the body and negate those already in place. It also attends to the notion of the imperative (Lingis, 1998) and the ways in which objects draw us towards certain actions. For the technologies we enter into relationships with are not neutral objects (Ihde, 1993; Verbeek, 2005; Rosenberger, 2014), they constantly vie with our own designs. The transformations they bring about push us in new, and sometimes specific, directions. It is essential, therefore, that we understand how our relationships with technology form, what they mean to us, and how they *feel* to us. In doing so we can begin to ask questions about how to develop technologies which are more intuitive and build relationships which elevate technologies to have meanings beyond their applications – thereby promoting more efficient, effective, and environmentally-sustainable interactions (see, for examples, Verbeek, 2005).

Finally, this work is in response to Don Ihde's (1993) claim that philosophers must start looking forward and developing theories in and for a 'research and design' role. The ideas within this thesis can have broader applications than academia, for example by feeding back into the design and construction of new technologies. Some of these ideas have been mobilised in innovative ways to communicate my findings through novel demonstrations which are described elsewhere in the thesis.

In responding to these prompts, this thesis addresses a range of audiences. Predominantly, it speaks to geographical work on skill, technology, and experience. However, these topics are ones which often overflow disciplinary boundaries. Kinsley's work on technology, for example, draws heavily on the work of philosopher of technology Bernard Stiegler (see Kinsley, 2014; 2015) while much of the work in *Cultural Geographies'* special issue on skill draws on the cultural anthropology of Tim Ingold, who also makes a notable contribution in form of his own reflection piece (Ingold, 2018). Because discussions of skill, technology, and experience relate to a breadth of academic enquiries, it is perhaps natural that they should span multiple disciplines. This thesis' ability to address trans-, inter-, and multi-disciplinary debates is something made possible through its use of cybernetics, an inherently transdisciplinary study. However, geography is also well suited to such conversations due to its ability to speak across disciplinary boundaries and draw on the work of other areas of study. This trait, which has led to geography being labelled a "magpie discipline" (Bell, 2009), helps broaden the audience of my work and lets me synthesise concepts for a wide range of fields. The relationship between geography, cybernetics, and transdisciplinary study is something I return to in the conclusion, where I reflect on how I have applied work to different contexts and whether geography continues a legacy left by cybernetics.

Another prominent audience is my participant group. While archers lacking social science training may be unfamiliar with some of the specific concepts I draw from the literature, the thesis is written in

such a way that archers could apply the concepts to their own training. This is particularly true of the empirical analysis seen in chapters seven through to ten.

The technologies discussed within are not restricted to the large, machine-based constructs that the term often evokes. Here the term includes, and focuses on, the more mundane objects with which we share the world. As such, it sits within a wider vein of work, for example that of Philosopher of technology Don Ihde (1993), who points to the radio and clock as being the two most influential technologies in Western civilisation. They, respectively, enable mass communication (and therefore education) and a universal time-based structure. Similarly, pen and paper, through their very mundanity, have similarly done much to shape our world and our lives. Their simplicity is what enables their ubiquity, it encourages their pervasiveness and with them ideas have travelled across the world and through generations. Shoes have provided us with the ability to walk over harsher terrain and longer distances without injury (Michael, 2000) opening up new spaces to our daily lives. A more recent invention – the e-reader – has been the source of a great deal of academic interest, with literary theorists N. Katherine Hayles (2002) and Matt Hayler (2015) exploring the ways it has transformed reading practices (see also Mangen, 2008). These mundane technologies therefore play a significant part in shaping human history. The technology at the core of this study – the bow and arrow – has held just as (and perhaps more) significant a role, as I will now explore. The bow and arrow – the technology at the core of this study – has arguably held an even more significant role in shaping human history, as I will now explore.

1.1 Archery as a Field Site

The precise age of archery is unknown. World Archery, the international federation responsible for governing the sport, states that archery has existed for 22,000 years (WA, 2006); yet anthropologists and historians more commonly estimate that bows and arrows have been in use for 50-80,000 years (Shea, 2006; Shea and Sisk, 2010; Lombard and Philipson, 2010; Brown et al, 2012) based on fossil records and archaeological findings. Since its inception, the bow and arrow, alongside other complex projectile weapons, has helped shape the evolution of early humans. One way in which they have done this is by providing humans with a way of "killing at a distance" (Churchill and Rhodes, 2009). Killing at a distance reduces the risk to self when hunting larger and more aggressive prey, and it opens up new spaces for hunting – such as open ground, where closing distance without being spotted would be implausible (Churchill, 1993). The development of the bow and arrow has further been linked to

changes in human cooperation and the forming of 'coalitions', as projectile weapons enable and encourage many-on-one hunting styles (Bingham, 2000).

While certainly not the only influential technological advancement that occurred during this period, the bow and arrow has proven to be unusually enduring. Many other technologies from this era have been further developed beyond recognition, replaced, or rendered obsolete, but the bow maintained its position as a primary method of hunting and warfare until the advent of gunpowder. Even then, archery continued to be used for hunting and flourished as a form of leisure and cultural activity. As such, the bow and arrow have remained near-constant companions to humans for millennia. During this period the bow, arrow, and techniques for using them have shifted, developed, and transformed – but never sufficiently to lose the connection to their history. While the bow and arrow have not remained stable in design, the principles have retained an elegant simplicity as they have re-emerged as a popular pastime. In America, Archery Trade Association surveys showed that the number of archers rose from 18.9 million in 2013 (Archery 360, 2013) to 21.6 million by the start of 2016 (Archery 360, 2016) representing a growth of nearly a million people per year. Despite this, literature in geography, and social science more generally, has so far not attended to the life of the bow and arrow; nor considered the way it, as a technological artefact, has transformed our understanding of space by permitting us to kill at a distance. This embodied practice has been largely ignored as other martial arts, such as boxing (Wacquant, 1995; 2011), karate (Cohen, 2006), capoeira (Stephens and Delamont, 2013) or Mixed Martial Arts (Green, 2011; Spencer, 2012; 2013; Hirose and Kei-ho Pih, 2009) have taken the spotlight in academic study. It was archery's absence from the literature, combined with its popularity across the world, which first drew me to considering it as a site for my research.

Following what has been described as 'philosophy of technology's empirical turn' (Acherterhuis, 2001) scholars of postphenomenology have become proponents of focusing on concrete examples of technology, rather than discussing technology in general as an abstract and monolithic 'thing'. For this reason, I have chosen to focus solely on archery and the role of the bow and arrow. Doing so enables me to engage with the empirical specificities of the object of study, and to see how the sport is enacted in practice. In essence, I choose to focus the discussion in this way to explore the context of, and meaning behind, the encounter without rendering the bow as just 'Technology' (after Acherterhuis, 2001) or constricting the learning of archery to a generalisable pre-determined skill development model. The emphasis on a singular technology, when coupled with the ethnographic methodology, produced a level of intimacy with the practice, thereby granting me access to its corporeal and affective dimensions. Yet, archery is a complex and dynamic practice and so this thesis cannot attend to every aspect of the sport which might be geographically interesting. Instead, I am focusing on the notion of becoming skilled in the practice of archery – a skill which has, for much of human history,

been a matter of life-or-death. Within this area I shall focus on the *experience* of the relationship between archer and equipment; with how it *feels* to interact with the technology, and how (or if) the technology becomes something independent of the human user being key points of enquiry.

With this focus, the thesis builds upon themes of the embodied experience of martial arts found in social science literatures. Following the cultural turn, and the subsequent emergence of non-representational theory, social science disciplines including geography, anthropology, and sociology have shown an increasing interest in embodied experience. One particularly powerful way that this has been studied in through ethnographic research on martial arts. Martial arts are deeply corporeal practices; they evoke intense sensations of pain, anxiety, and fear – sensations that we normally seek to avoid. Yet, paradoxically, these sensations may play a role in the appeal of martial arts (Green, 2011). This has provided an opportunity for social scientists to study the affective dimensions of corporeal practice, particularly calling into question pain's effect on the body (see Green, 2011; Spencer, 2009). By using archery as a case study, I can similarly observe a wide range of affective and emotional responses of the body – both the 'everyday' (such as tiredness, happiness, distraction) but also the more extreme and specific, such as panic and pain.

However, archery also provides an opportunity to introduce a new aspect to this focus – technology. Archery provides an opportunity to press away from the humanistic emphasis of the established literature. While the martial arts studied so far have been inescapably wrapped up in technology – whether it be the boxer's gloves and mouth guards, the karateka's gi, or the MMA cage itself – this is even more the case for archery where technical skill is as essential for high performance as embodied knowledge and physical ability. By introducing this technical dimension to the study, the thesis makes an original contribution by looking to "extend experience trans-humanly" allowing the "analytic focus to be decentred from and extended beyond the human body, taking in the inhuman … and nonhuman" (Lea, 2009b: 374). This recognises that "experience does not just occur within the body, confirming our boundaries and corporeality, but rather is a creative force distributed across bodies and worlds" (ibid). As a field site, archery, therefore, brings together the corporeality of martial arts literature and the more-than-human emphasis of technology studies. In doing so it raises questions about how the affective dimension of practice can be communicated between human and nonhuman elements of a system, the shapes and kinds of relations that form between people and technologies, and the agency of technology.

The kinds of relationships between the humans and technologies bound up in archery are also distinct. Other technologies which have drawn academic interests, such as smartphones (Swan, 2009; 2012), have become ingrained in our everyday lives. They have become routine, and so our engagements

with them remain largely un-reflexive. The bow, by comparison, requires active and conscious engagement. For an archer to become skilled in its use, as will be discussed later, they must be aware of, and reflect on, their relationship with their equipment. In particular, they must be able to recognise, understand and adjust the flows of information between different components. This, I believe, enables archers to more readily discuss their relationships with the technologies of their practice, as the ability to do so is a prerequisite of the sport itself.

Furthermore, the bow is distinct from biomedical prosthetics such as artificial limbs (such as in Murray, 2004) which are used to 'restore' the body. The bow does not 'replace' any pre-existing body part (or body ability) but rather introduces something entirely new, necessitating a renegotiation of understandings of, for example, space and distance. By not seeking to 'stand in' for something, the bow is also situated as an entirely optional technology to be brought into a relationship with the body. Considering these points together, this study casts the bow as a technology which requires deliberate, voluntary, conscious interaction. As such the human-nonhuman system that is the archer has the potential to teach us much about developing engaging with technologies in a more reflective manner.

In summary, archery is a performance of a more-than-corporeal body. One in which performers must recognise the participation of technological elements. As such it differs from previous martial arts field sites by focusing not just on human experience, but also inhuman and nonhuman experience. By attending to a site in which the position of the technology is more readily considered I believe that we can learn about making our relationship with technology more meaningful. That is, that we can learn to avoid rendering technologies to mere objects of use, thus encouraging people to care for and repair the 'things' in their lives. We can also seek to answer questions about the limits of the body and the limits of the human, calling into question the boundaries between life and nonlife, human and nonhuman, technological and corporeal. As such this thesis not only intends to explore the relationship between humans and technologies, but also to disrupt our current understandings of what it means to be use technology skilfully.

1.2 Situating the Thesis

In this section I explore two further areas of literature that this thesis builds upon: geographies of skill and geography and affective atmospheres. Each of these concepts is pertinent to the theoretical and methodological underpinnings of my work and I seek to make contribution to both in my empirical chapters. As debates about particular aspects of skill and atmospheres are discussed further

throughout the thesis, I limit my discussion here to providing a general overview of contemporary issues within the respective areas and drawing links between these and my own work.

Geography and Skill

Geographers' interest in skill is wide ranging and few practices have escaped geographical enquiry: from hairdressing (Ocejo, 2017) to taxidermy (Straughan, 2018), musical performance (Payne, 2018) to the art of simple living (Hunt, 2018). This research can be placed in two general streams; the first stream, which is of interest to this thesis, explores skill as a cultural and embodied practice while the second views skills as a political resource and mechanism through which to discuss processes such as migration (such as Mills, 2019). To date, geographers often approach the issue of skill through studies of craft practices (as is exemplified by many entries in Price and Hawkins (2018) *Geographies of Making*). In part, this likely stems from the influences of Ingold and Sennett whose works are frequently sources of influence for geographers working in this area. For Sennett, craftwork is not just a process of making things, but of "making things *well"* (2008: 8, emphasis added). In other words, craftwork is skilful making. My decision to focus on skilled performance in a sport rather than an art (as far as they can be distinguished) is an opportunity to explore skill from a less well-established angle. This enables me to make contributions based on the kinds of experience that occur. For example, in my debates around (physical) pain, the specific kinds of pain are distinct from those discussed in other crafts, for example writer's cramp (Quartarone et al, 2006).

In the context of this thesis, skill is understood to describe an ability to consistently achieve the objects of a practice. As such, skill can look very different depending on the practice. Skill provides a temporal dimension to discussions of technological mediation; although skill is often implicit when postphenomenologists speak of embodied technologies becoming transparent (see Chapter Three) it is rarely discussed explicitly. By bringing debates about technological mediation into conversation with geographical literature on skill, this thesis unpacks what it would mean for a technology to become transparent and whether it is accurate to claim they do. Latham and Wagner (2021) use the concept of 'thresholds' to think about the temporalities of skill development as moving from "an ability to do something, to being capable but awkward or inaccurate, to being proficient, to being highly skilled" (pg. 99). As this thesis will explore, the sense of proficiency and/or awkwardness in a practice can be reflected in the practitioner's relationship with the technologies they are using meaning an archers' (dis)comfort with their bow can be indicative of their skill, a pattern that is yet to be explored in the literature.

But the trajectory Latham and Wagner outline is by no means linear. As they note, it is pitted with "fits and start, with progressions and retreats, and sometimes ceilings that cannot be passed" (ibid; see also Lea, 2009a). The ability for skill to be disrupted is the second reason that my study sits within geographical interests on skill. Within postphenomenology, discussions of technological mediation failing are ladened with neo-Heideggerian assumptions which predominantly assign fault to the technology. Geographers have instead sought understandings that dis-locate power and agency in the performance to suggest that disruption to skill may occur due to a lack of experience on the behalf of the practitioner (O'Connor, 2007), unexpected environmental or atmospheric changes (Bissell, 2012), or even the agency of the materials themselves resisting (Straughan, 2015). Ingold's work has been particularly influential here, and 'ecological' understandings – which see skill as distributed across a network of more-than-human actors – are the presiding approach within geography. My work builds upon, and challenges, these ideas to suggest that skill is located – and thus disruption occurs – not across actors but in the spaces between them. By contributing to this discussion my work stands to further develop our understanding of the role of environments and tools in skilled practices.

Geography and Affective Atmospheres

The ephemerality of atmospheres evades easy articulation. We know them when we feel them, but at times the gulf between *feeling* and being able to *explain* is all too evident here. For McCormack, atmospheres are "something distributed yet palpable" (2008: 413) – they surround and encapsulate us. Böhme compares them to a haze (1993) capturing some essence of the palpability McCormack describes. Like a haze, atmospheres give an illusion of tangibility as they press upon us (Anderson, 2009) with more severe or intense atmospheres exacerbating this, giving way to the idiom 'to cut the atmosphere with a knife.' In the simplest sense, atmospheres can be thought of as a mechanism for the conveyance of affect or as a means for transmitting and framing more-than-representational experiences. Within this thesis, the concept of atmospheres is used to engage with the context within which archery is performed and as a determining factor in skilled performance, as noted in the previous section. They also provide an avenue for nonhuman intervention into archery and are prominent in my discussions about the role of the range.

Bille captures the practicalities of experiencing atmospheres through his work on light. Light, he argues, does not merely illuminate does so "in a particular way, through shadows, tones, contrasts, darkness" (2015: 259). Similarly, atmospheres are not always felt directly but may make their presence known through their ability to frame other events and experiences. While the term is not used in archery, the concept of atmospheres is very much present. In Chapter Eight, I discuss how archers use

a process that they call ‘distraction training’ to prepare themselves for the instability of the atmospheres within which they perform. This training gives archers the ability to make small adjustments to their approach to ‘attune’ (Merchant, 2011; Allen-Collinson and Hockey, 2011) to their environment. By letting existing geographical literature on atmospheres inform my approach, I work to better centre the role of nonhuman agents in my understanding of archers’ experiences and attend to the prominence of affective disposition in skill.

Although atmospheres have been widely used to explore nonhuman materialities (for example, Bille, 2015; Ash, 2013; Degen et al., 2015) they have remained primarily anthropocentric through their focus on how these materialities frame human experience (Lorimer et al., 2019). Recent work has sought to question what atmospheres would look like without a sensing human subject by applying them to animals’ experiences of the Anthropocene (ibid). These ongoing developments stand to expand the potential applications for atmospheric approaches; I aim to contribute to this discuss through the introduction of cybernetic theory. Using the concept of ‘noise’, in Chapter Eight I provide a means for thinking about atmospheres through the relatively neutral language of communication.

2. Introduction

So far, I have outlined the importance of this thesis and introduced its narrative. I have explained why both technology and martial arts are rich sites for academic research, and why archery provides the opportunity to bring these two areas into conversation. Within this chapter I move to outline the structural element of the thesis through three areas. These are: to introduce, define and clarify a few key terms used throughout this work; provide and contextualise the aims and objectives of the study; draw links to the more-than-human geographies that have influenced the thesis; and outline the overall structure of the thesis.

2.1 Naming nonhumans

As I have already shown, the centrality of nonhumans to our lives is a widely studied phenomenon. The diverse array of fields that have sought to explore, map, and understand our relationship with these nonhumans have produced a myriad of terms for the nonhuman, each carrying its own inflections. They have been variably called '(nonhuman) things' (Latour, 1993; Brown, 2004), 'objects' (Harman, 2002), 'technologies' (Heidegger, 1954; Barratt, 2012; Hayler, 2015) and 'units' (Bogost, 2012) to name but some of the most prevalent terms. These terms are sometimes used interchangeably – Verbeek (2005) transitions between 'thing,' 'object,' 'technology', and 'artefact' without any discernible difference. At other times, the words are seen as replacements of, or challenges to, one another: for Heidegger (1971) a 'thing' is a craftwork to be celebrated, whereas an 'object' is "abandoned to the empty mastery of science and technology" (Latour, 2004: 233). Latour disputes this claim as being "justified by nothing except the crassest of prejudices" (ibid: 234). Similarly, Bogost (2012) opts for the term 'unit' over 'object', in part, because having an 'object' implies the presence of a 'subject'. To further complicated the terminology, some terms are occasionally combined – Verbeek (2008) talks of 'technological artifacts' [sic] as a specific subcategory of artefact. If one wishes to draw on the works of more than one of these authors, the result is a minefield of technical language that may make the topic impenetrable to the uninitiated. For clarity, I will briefly outline which terms are featured within this work and what they are intended to refer to. I will not, however, feign fidelity to definitions used by the authors above, nor shall I sacrifice coherence for specificity.

Despite Bogost's criticism, the term 'object' will feature in this work, whereas the term 'unit' will not. Bogost's suggestion that an 'object' presupposes a 'subject' is only true of the most literal

interpretation of the word. The issue of a subject/object dichotomy is more directly challenged elsewhere in this thesis. The term 'object' is used here to be interchangeable with the term 'thing', both describing any nonhuman entity. Smith (2003) has similarly conflated the terms 'nonhuman thing' with 'technological artefact' when comparing the respective works of Latour and Ihde. Smith acknowledged that the terms, while meaning much the same thing, have idiosyncratic inflections. But he further maintained that any loss of specificity was more than compensated for by the gain in coherence. I would make the same argument here for 'object' and 'thing'.

In addition, the terms 'technology' and 'artefact' feature; both are used to describe a nonhuman thing (or object) with a sense of 'made-ness' about it. While 'artefact' will describe the specific instance of a made thing, 'technology' will describe its phenomenon more broadly. To provide an example; chairs are a technology, a specific chair is an artefact. This draws on etymological root of the two words. Technology comes from the Greek *tekhnē* meaning craft, skill, or art, whereas artefact comes from the Latin words *arte* – meaning 'from art' – and *facere* – 'to make'. Each, then, carries connotations of creation and artwork, connotations which are reflected by their use within this thesis. But the requisite made-ness of an artefact or technology does not presuppose physical construction, but rather refers to a (re)purposing, a (not-necessarily-physical-) transformation. Through such an understanding a tree stump can be 'made' into a chair simply by sitting on it. Furthermore, as has been stated previously, technology is not a purely human activity. As such, a fallen branch – an object – becomes part of an artefact if converted into a human's hammer, but equally so if made into a bird's nest of a beaver's dam.

Just as discussions of the nonhuman have produced an expansive vocabulary, questions of the more-than-human have led to an array of terms being formulated too. Of these concepts, the most prevalent in this thesis is the 'system'. Emerging, in this context, primarily from cybernetics, the 'system' reflects the fields roots in systems theory and computer applications. For cyberneticists, the system can be a unit of analysis, the sum total of the substrates and the information flowing across them (see Wiener, 1948; Giddings and Kennedy, 2008). Unlike 'networks' and 'assemblages', discussed below, debates surrounding what constitutes a system are sparse. Within this thesis the term refers to any combination of human and/or nonhuman things acting together and oriented towards a specific goal or purpose. The term system, therefore, has no implied scale. Any system can be – *and likely is* – comprised of multiple subsystems and exists as one of several subsystems nested within a larger system. The cybernetics system, its constituent parts and properties are further discussed in the literature review.

Elsewhere the term 'network' has been used, predominantly within Science and Technology Studies (STS) and Actor Network Theory (ANT) (see Latour, 1988, Law, 2008). The notion of the network has been criticised by others, such as Ingold (2007), for being skeletal – that is, for lacking a thickness to the relations between nodes. As will be returned to later, Ingold believes that network approaches such as ANT are centred on the nodes, rather than the relationships which connect, and arguably give meaning to, them. This reduces the ability for network approaches to appreciate the journeys and flows which occur between actors and are central to this study. Although Ingold proposes his own alternative – meshworks – I believe that where the ANT network falls short, the cybernetics system flourishes. With the concepts of 'feedback' and ''noise' cybernetics provides a language which not only attends to these journeys and flows but foregrounds them.

The third term, and perhaps the most prevalent within contemporary geography, is the notion of the assemblage. As Anderson and McFarlane identify in the introduction to Area's special issue on 'Geography and the Assemblage' (2011), "there is no single 'correct' way to deploy the term" (pg. 124) due to, and perhaps perpetuating, the broad variety of contexts in which it is used. Much of the work done with assemblages, however, shares a heritage with the work of Deleuze and Guattari (1986; 1987) both of whom were heavily influenced by the cybernetics of the 1950s. For Deleuze and Guattari the term refers to a "'constellation' of elements" (Anderson and McFarlane, 2011: 125). Within this thesis the term is deployed in such a way to reflect this notion of a 'constellation' whilst remaining interchangeable with system and not being overburdened by the term's diverse, sporadic, and at times, contrary history of applications. This reflects the (rarely acknowledged) cybernetic influence on Deleuze and Guattari and many of their contemporaries, and therefore its spectral presence in much of twentieth century geography.

Thus, in summary, the terms 'object' and 'thing' are used as interchangeable terms to refer to any nonhuman entity. 'Artefacts' and 'technologies' refer to nonhuman things but imply a made-ness, and where artefacts are concrete, specific instances, a technology refers to the broader phenomenon of an artefact. 'Systems' and 'assemblages' are gatherings of humans and nonhumans orientated to a specific task or purpose. Or, to define them through an example: a stone is an object or thing, when carved into an axe-head it becomes an artefact and when attached to a shaft it becomes an assemblage, or system, in the form of an axe[2].

[2] It is worth noting that artefact/technology and system/assemblage are not mutually exclusive. A specific axe is an assemblage/system and an artefact, and axes in general are technologies and assemblages/systems.

2.2 More-than-human Geographies

Underpinning this exploration of archers and their equipment is the belief that archery is not solely a human practice, but rather a more-than-human one. My research considers the non-human actors (the bow, the range, the etiquette and procedures, the weather and so on) as equally being participants in the performance of archery and so must give voice to them to reflect this. More-than-human studies have a rich history in geography[3], and in this section I briefly introduce the two ways that they have shaped this research: scope and methods. In the first section I discuss what it means to be more-than-human and why the more-than-human is of interest to geographers. In the second section, I turn to the methodological requirements of more-than-human study to explore whether attending to the non-human and inhuman requires different means of data collection. Here I consider how others have approached more-than-human research and how the overarching narratives inform my work, but to avoid repetition limit my discussion of the logistics of my own more-than-human data collection which is discussed in full in Chapter Six.

A more-than-human scope

Rather than describing a specific remit of study, it is perhaps easier to think of more-than-human geographies as a description of what research *is not*. That is, it is not (or, at least, tries not to be) anthropocentric and humanist. Through a more-than-human approach, geographers seek to recognise the agency of the nonhuman and inhuman with 'more-than-human' becoming an umbrella term to refer to human's interactions with non/inhumans without using a 'human-other' framing, although these are nonetheless prevalent within the literature. Through this approach, geographers have attended to a breadth of more-thans, including, but not limited to, human-animal (Buller, 2015), human-plant (Pitt, 2015), human-microbe (Blue and Rock, 2020), human-pollution (Evers, 2019) and human-technology relations (Barratt, 2011) as well as combinations of these (such as Hinchliffe, 2021). Through its non-specificity, the term 'more-than-human geography' works to avoid reinforcing narrow categorisations such as these (Dowling et al, 2017), allowing for geographers to recognise how, for example, human-animal relations may be characterised by bodies that are neither human nor animal

[3] It is worth noting here that more-than-human approaches have an even richer history outside of Anglo-European academia (Evers, 2019) and have been a feature of Indigenous scholarship, storytelling, and belief for some time (see, for example, Wright et al, 2012).

(such as diseases). Furthermore, it provides space to attend to complex "hybrid figures" such as cybernetic and genetically engineered organisms (Greenhough, 2014: 97).

My work sits within more-than-human geographies due to its recognition of material agency. Vital/new materialism has been a significant influence of more-than-human geography (Evers, 2019; Greenhough, 2014) in terms of both epistemology and ontology, and their influence on parts of this thesis is discussed at length in Chapter Nine. There is significant work using more-than-human approaches to understand skilled performance in sports and leisure activities (Jones, 2005; Spinney, 2006; Dant and Wheaton, 2007; Barratt, 2011). These approaches share an interest in how the tools and technologies of the practice are central to its success or failure and how their agency is understood by practitioners. For example, Barratt's (2012) study of climbers found that six of his forty participants described their equipment as "magic" without being prompted (pg. 49). The 'magic' that these participants describe is their interpretation of an expression of the equipment's 'vitality' (Bennett, 2010). As I will discuss in Chapter Nine, my participants similarly discussed the agency of the equipment and frequently ascribed it with lively personalities. Like Barratt's climbers, they found the alterity of the nonhuman other difficult to capture, often falling on metaphor, analogy, and elements of mysticism to convey their experience of co-operating across a perceived human/non-divide.

The more-than-human approach benefits from the work of cybernetics, which sees the distinction between humans and nonhumans as being largely unnecessary when speaking of the flow of information in a performing system (see for example Lister et al., 2003). The combination of these works to overcome the limitations of Ihde's postphenomenology and broader neo-Heideggerian approaches (e.g., Hayler, 2015) which depict human-technology relations as being comprised of a human "augmented by the equipment" (Hayler, 2011: 51-52). While it is fair to focus on how technologies shape and alter human experience – as I do myself – it is equally important to not render technology as a subordinate partner or mere tool. As this thesis aims to show, technologies are not merely supplementary to human bodies, but possess their own social and material worlds and exhibit their own agency. An attentiveness to the more-than-human can work to de-centre human experience from the focus of research and deconstruct rigid interpretations of what it means to be (non/in)human. But if more-than-human geographies are to be understood as a means for recognising that experience is felt beyond the confines of a human body, and that 'the human' itself is a processual creature always in the process of unfolding through, into, and alongside 'others' (Greenhough, 2014), then post-phenomenology is perhaps a natural continuation.

Geographical attention to the more-than-human has also included attention to the spectral and debates about absence and presence. Within this work, the experience of absence is a core concept

for understanding certain types of technologized relation – primarily Ihde's notion of background relations (Verbeek, 2005). As discussed in Chapter Three, background relations are characterised as shaping our experience without being consciously experienced themselves (Verbeek, 2005: 125). This is pertinent for studying archers, where the elements of the range can form background relations with archers. The use of spectral geographies enables me to grapple with the implications of absences – of sound, heat, people – on the range. For archers, these absences are more tangible than their respective presences, and learning to navigate them forms a specific part of an archer's training (see Chapter Eight). But spectral approaches can also aid us in understanding sensations of loss within our own bodies, as Sobchack's (2010) account of experiencing phantom limb syndrome serves to demonstrate. By acknowledging that absence is an experience and not simply the lack of experience, more-than-human approaches can attend to the more-than-present providing space for geographers to think about the disruption of skilled performance in new ways.

Since the more-than-human turn and Whatmore's first reflections on the matter (2002; 2006), the proliferation of the term has continued throughout a breadth of geographical subdisciplines. Yet, the term is perhaps becoming redundant as contemporary philosophical traditions, such as the post-phenomenology used within this thesis, are founded on the view that researchers should look to participants beyond the human. For those engaging with such practices, anything less than a more-than-human approach would be fundamentally flawed.

Doing More-than-human research

In recognising the prominence and agency of non- and inhuman participants, a more-than-human perspective invites geographers to rethinking their approaches to engaging with research, and to open new kinds of "research relationships" (Dowling et al., 2017: 824). More-than-human approaches call for and enable research which spans across disciplinary boundaries (Greenough, 2014) and thus draws on the methods of those disciplines. Notable influences in more-than-human methods are drawn from biological sciences (Hinchliffe et al., 2005), the arts and creative fields (Hawkins, 2015), and the technological fields my own work draws on. These interdisciplinary methodologies enable geographers to draw on methodological tool which may be better suited to accessing the lives of nonhumans. This section attends to some of the ways in which more-than-human geographies have called for new, or altered, methodologies. As I have noted in the previous section, there is considerable overlap between more-than-human and post-phenomenological geographies; this is equally true for the kinds of methods they call for. As I discuss the links between postphenomenological approaches and my research methods in Chapter Six, I focus my discussion

here on a more general methodological shift resultant from the more-than-human turn. Dowling et al. (2017) draw a distinction between the application of 'conventional' research methods to more-than-human fields and subjects and those novel methodologies which seek to innovate the ways we attend to more-than-humans. Although I do not find such a straightforward divide entirely convincing, it provides a desired clarity and so I replicate it here.

Although many qualitative methods have been applied to more-than-human geographies (Dowling et al., 2017), both interview and ethnography are popular ways of engaging with animal (Probyn, 2014), plant (Pitt, 2014), and technological (Barratt, 2012) nonhumans. These approaches often use the nonhuman presence as a prompt for discussion with human participants, thus opening them up to the Kullman's (2016) broad critique of research on human-technology interactions: that nonhumans are merely seen as 'props' in the stories of human actors. To do so is unfaithful to the more-than-human approach's call to decentre human experience in research (or, perhaps, to decentre experience from humans (after Lea, 2009)). Within my research, methods which attend to technology 'in action' have allowed me to focus on the relationship between humans, technology, and the environment as the subject of study rather than solely the archers. Barratt (2012) has taken a similar approach by bringing climbing equipment to interviews so that participants could 'speak' through corporeal engagements. Barratt seeks to recognise how these engagements are technologically mediated, and thus that the participant is in fact a more-than-human. As Hinchliffe et al. (2005) describe in their attempts to navigate water vole "writing" – the footprints and detritus the water vole leaves behind – attending to more-than-human participants is a process of learning to be affected. Calls for more-than-human research to extend the repertoire of sense used in research – to move away from a reliance on reading and writing, speaking and listening (Whatmore, 2004) – signal to the non-representational roots of more-than-human geographies (Greenhough, 2014). But for some, this raises questions as to whether there are limits to the extent that we, as researchers and as humans, are capable of opening ourselves up to being affected by more-than-human others (ibid). One response to this has been the development of what Dowling et al. (2017) describe as "more innovative" methods capable of "embracing the messy-ness of entangled worlds" (pg. 825). I turn to these now.

As more-than-human methods seek to attend to specific combination of (non/in)humans present, the variety such approaches take has no real limit, instead adapting as appropriate. Dowling et al. (2017) discuss a number of these, but here I focus primarily on one theme: creative research practices. Over the past decade, geography has developed an "increasingly vibrant" (Hawkins, 2018: 247) relationship with making practices that shows no sign of diminishing (Price and Hawkins, 2018). These studies have developed innovative methods for researching with and through nonhumans others including bees (Adams, 2018), bacteria (Ocejo, 2017), and the dead (Straughan, 2015). A core part of this has been

the decision to enact 'messy' methods. Drawing on Law's (2004) work, messy methods acknowledge that more-than-human worlds defy neat categorisation and thus resist methods which would seek to apply such categorisation open them. Messy methods can provide unexpected, often unexpectable, outcomes (Jungnickel, 2018), but creative research methods are characterised by an emphasis on processes rather than outputs (Hawkins, 2019) and so are well suited to immersing the research within mess, and sensitising researchers to the affects of a more-than-human field. Within post-phenomenological geography, researchers have used design methods to facilitate their discussions of technological mediation (Kullman, 2016) following Ihde's imperative for researchers to move into 'R&D roles' (1999). Design methods focus attention on the conversation between the maker/researcher and their materials, Gore (2004) discusses his architecture students use of 'material experimentation' as a means for helping them learn the behaviours of the materials that they were using. These behaviours were emergent, only becoming apparent in certain situations and alongside certain other materials, and thus could only be seen by studying the material in practice. Creative research methods adopt similar principles to focus on the unfolding of the more-than-human relationship and, since Crang's (2003) assertation that for a characteristically 'touchy-feely' discipline, geography involved remarkably little touching or feeling, creative methods have represented a concerted effort to engage with more affectively, corporeally, and materially sensitive methods, making them well suited to navigate the meanings derived from specific kinds of affectivity, corporality and materiality.

In summary, the more-than-human turn has resulted in a refocusing in geography and a turn to consider the importance of nonhumans and inhumans and the ways in which they are imbricated in various practices and processes. This has been met by a shift in how we think about doing research and calls for methods better suited for engaging with different kinds of bodies and materiality. However, the more-than-human turn has become so sedimented into contemporary geography, that much work that could be described as such falls under another heading – including post-phenomenology. Post-phenomenology's effort to decentre experience from humans (Lea, 2009) is a clear indicator of its – and my – more-than-human influences. Throughout this thesis, my work serves to demonstrate how geographers can adopt postphenomenological influences to attend to the more-than-human nature of practice by centring their research methods on the relations between actors rather than the actors themselves. Through cybernetic concepts like noise and feedback, I will contribute to understandings of how different mechanisms – notably atmospheres – facilitate more-than-human communication and can be valuable sites for future research.

2.3 Aims and Objectives

The primary aim of this thesis is to develop an understanding of the ways in which humans become part of more-than-human systems, whilst exploring the transformative propensities of objects. I have chosen to undertake this study within the context of martial arts because there is an especially strong emphasis on such relations and assemblages within the practice. I have selected an archery club as my field site because of the sport's long and complex history which has produced a variety of detailed and dynamic approaches to such relationships – archery is, in essence, a complex and intimate encounter between fleshy and mechanical bodies. To achieve these aims, I have designed four objectives to fulfil:

My first objective is '*to understand the processes by which the body is transformed to work alongside a prosthetic element in an assemblage or system with different (spatial) capacities.*' The objective's focus on spatial capacities reflect archery's position as one of a small number of long-distance martial arts. The objective works towards an understanding of the (re)shaping and (re)structuring of body, mind, and prosthetic/tool as a result of skilled practice and entering into a more-than-human system. It endeavours to recognise that the changes brought about by this are not restricted to positive enhancements but can and do also include additional constraints and limitations, or transformation which entail no practical gain or loss. In the process of attending to this objective, questions of object agency are brought to the fore in analysis of the works of Ihde (1993), Hayler (2015), and Heidegger (1954) who each describe processes of incorporation, a phenomenon similar to that which I engage with. However, within this thesis I take a critical stance towards notions of 'incorporation', which I suggest are necessarily anthropocentric and as such undermine and undervalue the agency of objects positioned within these systems.

The second objective is '*to explore the intimate and potentially productive geographies of (cybernetic) noise.*' This objective mobilises the concept of noise, drawn from the field of cybernetics where it refers to interference within a system, to describe, explore and understand specific training methods within archery. In attending to this objective, I consider the training method known as 'distraction training.' As I will outline later in the thesis, distraction training requires archers to continue shooting in artificially created subpar conditions – for example with other archers trying to talk to them or otherwise deter them. This is done to simulate, and prepare for, potential competition scenarios without the cost associated with failure. Within these sessions, I argue that noise is mobilised in such

a way as to become a beneficial component of a training regime, one which places an emphasis on focus and attention and thereby opens up new perspectives for geographical interest in these areas.

The third objective is '*to understand the movement from hesitant bodies to skilled actors, with particular reference to how agency and affect(ivity) operate within more-than-human systems.*' This objective builds upon the work of objective two by developing a language, drawn from cybernetics, to discuss the flows of information – including noise and feedback – across more-than-human systems. Of particular interest to this objective is the transformation which such flows of information undertake in the development of skill, for example trained reflexes and instinctive reactions. In attending to this objective, I shall be building upon the literature outlined earlier in the prologue – particularly responding to the provocations stemming from Green's (2011) concept of 'forced reduction' and broader issues pertaining to more-than-corporeal embodiment and 'trans-human' understandings of experience (Lea et al., 2015). As such, this objective overlaps with objective two in its interest in the disruption to skill.

The final objective is '*to situate the specific spaces and practices of archery within the broader literature of geographies of embodiment, performance and practice.*' By responding to this objective, my work will resonate not only with that of academics with an interest in martial arts practice, such as those discussed earlier in this chapter, but with a broader field of literature on embodied practice. These works include studies on cycling (Spinney, 2006), skydiving (Anderson and Taylor, 2010) and yoga (Lea, 2009a). Through this, the thesis will endeavour to disentangle the empirical specificities of archery as a practice to further develop discussions of pain, affectivity, and embodied performance in sport.

In combination, these objectives will work to provide a thorough account of the transformations undertaken by objects and individuals as they work alongside other people and things in more-than-human systems. The objectives provide the opportunity to explore the human relationships with objects from an approach which does not place the human at the centre, but rather seeks to step back and apprehend as it continually unfolds in practice, and to see the relationships through which it is formed.

2.4 Thesis Structure

This thesis is formed of eleven chapters; within each of which is a short intervention with an area of debate with a self-contained narrative which contributes to our understanding of tool-use and skill development through the lens of archery. But, further to this, another story is woven through throughout the thesis as a whole, this is a story which intends to prompt debates how about how comfortably object fits into our lives, and how much (or little) thought we give to those things which inhabit the world alongside us, things without which we would not be able to lead the lives we do. Through this I hope to unsettle our current attitude towards the 'things' of the world – an attitude which is often framed by instrumental and utilitarian thought.

The prologue chapter introduced the topic and its narrative; it set the scene by drawing out the connections between key objects of study namely: tool use, technology, and archery. It indicated that there is much we can learn from studying archery, particularly by viewing it as a practice through which corporeal and technological activities are drawn together in such a way that participants are constantly reflecting on their practice.

Following this, this introductory chapter sought to clarify how some of the fundamental terminology is deployed in later chapters. This chapter has also provided room to detail the specific aims and objectives of the study, and to expand on their relevance to my interest. It functions as an introduction to the thesis as a whole, outlining the structure.

The next three chapters form my literature review; the first of these, chapter three, introduces the phenomenological approach to studying technological relations. It sets out two distinct understandings of postphenomenology – one drawn from geography, the other from Don Ihde's philosophy of technology. Both are used throughout the thesis. The first half of the chapter is dedicated to identifying the interwoven histories of the approaches. This is done to reconcile the divide between the two, not by collapsing them in on one another but rather by providing a bridge across which they can engage in productive dialogue and over which conceptual tools and ideas may be leaned.

The second literature review chapter, chapter four, turns its focus to overcoming assumptions. The literature within, drawn from a wide range of disciplines, tends to provoke questions rather than answers, and through this I will consider the issue of the limits to the body. The chapter explores limits in both physical and cognitive senses. Through the literature it argues that the body's boundaries, should they exist in any discernible way, are diffuse, dynamic, and actively maintained. It makes use

of a selection of literature ranging from biomedical prosthetics, tool-use, and cognitive psychology. A key point within this chapter is to identify that many attempts to map or model the skilled use of mediating technologies broadly follow Ihde's depiction of embodied relations. As such they position themselves as human-centric, with technologies rendered 'transparent' as they are 'incorporated' into the body. This viewpoint is presented here to be explored and critiqued through the empirical work later in the thesis.

The final literature review section – chapter five – introduces cybernetics. Cybernetics, the study of control and communication across systems, provides much of the language used within this thesis to describe flows of information across more-than-human systems. The chapter builds on the need to focus on relations and the acceptance that information crosses conventional (nonhuman and human) body boundaries identified in the previous two chapters. The chapter starts by introducing the history of cybernetics through key moments in its development. It then turns to look at communication in general sense and then two specific instances of communication – noise and feedback. Some may consider cybernetics to be a dated approach, with the height of the field being the mid-twentieth century, but I make the argument here that the use of cybernetics provides much greater clarity in future discussion of communication within and across systems composed of both human and nonhuman parts.

Chapter six forms the methodology, in which I link my approach to the fieldwork back to the theoretical literature to justify my research design. This chapter further provides an overview of how the fieldwork was conducted and the ethical concerns raised and considered when interacting with people and objects during the course of the project. The chapter tackles the pragmatics and logistics behind my interviews and observations and charts the unfolding of the project overall. It also provides a reflective overview of my own relationship with the fieldwork, and how returning to a field site that had been of great importance to me raised questions about my identity.

Chapter seven is the first of three empirical chapters. This chapter works with Downey's notion of 'scaffolding' (Downey, 2008) and Clark's concept of wideware (Clark, 1999), both introduced at length in chapter four, to look at how skill, responsibility and agency are distributed across a more than human system. This chapter has a particular focus on the ways in which this distribution changes over time as practitioners become more skilled and instructors step back. It questions how the process of archery are distributed across more-than-human systems, and the consequences of removing any component of that system. Furthermore, for the uninitiated, it can serve as a rough introduction to archery by focusing on the content of the six-week beginners' course.

My second empirical chapter – chapter eight – draws on the concepts of feedback loops and noise, taken from cybernetics, to explore the ways in which experiences happen across more-than-human systems. Bringing them into conversations with the notion of a skillscape (Hunt, 2018), this chapter builds upon the work of the previous chapter to locate skill as communicative. The role of noise is also considered in discussions of the impact of interference to this communication, and the chapter poses the question of whether interference within a more-than-human system can be used positively.

Drawing the ideas of the previous empirical and literature review chapters together, chapter nine concludes my empirical section by asking what kinds of human-technology relations are occurring in the practice of archery. The chapter seeks to question the hegemony of models of incorporation and propose other ways of thinking through our relationships with technology based on those found in archery. It proposes that we can, and perhaps should, work 'with' rather than 'through' technologies thereby resisting the tendency to view them as transparent tools and incorporated prosthetics. The chapter uses the material of the previous empirical chapters to demonstrate how such a relationship can be seen in archery and how it can work positively.

In the tenth and final chapter, I conclude the thesis by drawing together the key points made in the empirical chapters and linking them back to the aims and objectives. The chapter further reiterates the contributions the thesis has made to the field, but also highlights areas for future research while acknowledging and attending to the gaps the approach this thesis has taken might have left.

3. Postphenomenology

3.1 Postphenomenology and ANT: Theorising Technological Relations

At the start of the introduction, I drew attention to the fact that human-technology relations are an undeniably important part of the construction of the world as we know and experience it. It should not, therefore, be surprising that considerable attention has been paid to the question of how we can map these relations. In the last half a century, academics from a vast number of social science disciplines have proposed different approaches. Scholars in science and technology studies (STS), geography, philosophy of technology and anthropology, to name but a few, have offered answers, each carrying its own disciplinary inflections. In 2008, anthropologist Tim Ingold published a piece of work highlighting this and comparing different approaches to thinking about the interconnectedness of things. In the chapter, Ingold embodies these approaches in arthropods – primarily an ant and a spider, with a butterfly making a brief appearance – each positioned as a caricature of the approach it represents. The ant stands in for Actor Network Theory (ANT) continuing a motif long used by Bruno Latour (1993; 2005). The ant embodies complex social networks, symmetry of agency between things and 'act-ants,' and collective agency. Ingold's spider, on the other hand, represents his own view that Skilled Practice Involves Developmentally Embodied Responsiveness. Contrary to the ant, the spider believes that relations have a material presences (much like its web) and that "the world… is not an assemblage of heterogeneous bits and pieces but a tangle of threads and pathways… a *meshwork*" in which "action is not so much the result of an agency that is distributed around the network, but emerges from the interplay of forces that are conducted along the lines of the meshwork" (2008: 212).

Although Ingold does not provide an arthropod equivalent for postphenomenology for me to use here, he does lay the groundwork for this chapter in two ways. The first is that he identifies a lack of consensus as to the best approach for mapping human-technology relations, particularly when it comes to the "problem of technological agency" (Rosenberger, 2014: 370). This is a question which I seek to respond to through empirical research later in this thesis. The second is that Ingold raises concerns about the suitability of ANT for answering such questions. In part exemplified by his claim that actor network theory's networks merely "join the dots" (Ingold, 2007: 47). By highlighting these concerns, he provides ample reason to look elsewhere for a new and innovative take on an old question. As discussed in the introduction, one of the benefits of a cybernetic approach is that it brings the journeys between points to life, this can work to supplement the focus of postphenomenology which is on the relationships between things rather than the things themselves (Ihde, 1993). Drawing

on its background in Merleau-Pontian phenomenology, postphenomenology offers an approach which balances the interest in technological relations with the rich descriptive narratives of its roots.

Another point raised by Ingold is that ANT has a long and complex past, leaving him with "reservations" about how terms like 'hybrid' have been deployed in varying ways (2008: 211). The ant suggests that the extensive past and wide range of applications count in ANTs favour, but the spider's retort hints at a muddled and confusing identity for ANT. Once more, I side with Ingold. Although the longevity of ANT is not inherently problematic, postphenomenology is still an emerging approach (within geography, at least), which enables it to offer the original and innovative angle which ANT could be seen to lack. While the post-phenomenology of geography has historically experienced identity problems of its own (see Lea, 2009b), the increase in authors identifying themselves as working within the field has allowed a more cohesive identity to take form in recent years (Lea, 2020).

My critique of the ANT is not meant to suggest that actor network theory and postphenomenology are mutually exclusive approaches. Hildebrandt (2007), Smith (2003), Verbeek (2005) and Rosenberger (2014) have all suggested that the two could "productively supplement one another" (Rosenberger, 2014: 372). But, as Rosenberger observes, their ability to do so stems from their differences as much as their similarities. He further identifies that postphenomenology is particular adept at delving into the nuances of individual instances of human-technology relations, whereas ANT has shown itself to be better suited to 'macro-scale' relations and how specific arrangements of humans and technologies have an effect on the world. It is the former that I aim to achieve in this thesis, and so it is postphenomenology which appears the more suitable.

I have focused on ANT here as it is perhaps the most 'classic' approach for studies of human-technology relations. But the specifics of this study lend it to favouring a postphenomenological approach. Having briefly made this argument with a cursory overview of both postphenomenology and ANT I now turn to setting out a more detailed description of what constitutes a postphenomenological approach. In doing so I further comment on its suitability for the project and open the way to weave in the themes and theories discussed in the rest of the literature review. But first I attend to some of the historical critiques of classical phenomenology.

3.2 Phenomenology and the Universalised Body

Before I turn to consider how (or whether) the two forms of post(-)phenomenology align, I use this section to explore a shared history by attending to one of the most prominently critiqued

shortcomings of classical phenomenology: Its universalised depictions of the body. Writing from a disability studies perspective, Reynold's posits that any attempt to philosophise about the body risks becoming a normative process because to "think about the body is to think about the conditions of the possibility of not just being but being *so*" (Reynolds, 2019: 439, emphasis in original)[4]. In other words, to engage in discussions of embodied experience is inevitably to make assumptions (explicitly or otherwise) about which bodies are doing the experiencing. For much of phenomenology's history, lived experiences of 'the body' referred solely to a specific kind of body – notably one that is white, male, heterosexual, and able-bodied (del Rio, 2009). In doing so, these accounts obscure and reproduce forms of oppression and privilege that are fundamental to the formation of day-to-day experiences and have drawn critique from other phenomenologists who write from feminist (Young, 1980), queer (Ahmed, 2006; Lajoie and Douglas, 2020), race (Alcoff, 1999), and disability (Reynolds, 2017) perspectives. This section will focus primarily on the critiques emerging from disability studies and feminist and queer literature as these are most explicitly linked to the theories and kinds of experience discussed throughout the empirical chapters. First, however, I turn to discuss what it means to speak of 'the body' and why I use this framing in the thesis.

In response to critiques that phenomenology presents an undifferentiated account of "the" body, Nagel rejects the term entirely. Instead, he chooses to speak in terms of 'embodiment', claiming that this helps to "avoid the metaphysical baggage that could come along with the seeming reification of "*the*" *body*, as well as the normative presuppositions that could follow" (2012: 23, emphasis in original). However, this position is far from universal. Many of the authors discussed in this section do speak of "the" body (such as Ahmed, 2006; 2007; Young, 1980) and I suggest that this is not intended to imply a *universality* of the body but rather a *specificity*. Throughout this section I will present critiques of phenomenology that see embodied experiences as being fundamentally constituted by the body itself. Put simply, this is a recognition that the experiences and experiencing of any given body are unique to that body and the bricolage of "historical, cultural, social, and economic limits" (Young, 1980: 138) that form its "situatedness" (ibid). From this position, the use of the definite article is necessary precisely because it matters which body is being discussed. I refer then to "the" body not because there is a single, undifferentiated body but because there is a specific, unsubstitutable body bound up in the formation of those experiences. To speak of *a* body or even *bodies* would imply a level of generalisability that is incompatible with this work. I turn now to ground this position in disability

[4] Note that this is strikingly similar to Ihde's critiques about philosophy of technology reducing technology to design functions (REF). There are definite parallels between debates about the body/bodies and technology/technologies as a sites of philosophical interest, however these are beyond the scope of this thesis.

studies and the idea of normal and 'abnormal' bodies before moving to debates in feminist and query theory which explore how embodied experiences of space through the lens of gender.

Presumptions of 'Normality'

Writing on the potential applications of phenomenology in understanding experiences of illness, philosopher of medicine Jonathan Scholl tackles what he calls the "presumption of normality" (2015: 400). For Scholl, this refers to phenomenology's tendency to conceive of disabilities as abnormal and in need of correcting. Scholl's work attends to one of disability studies' leading critiques of phenomenological accounts of the body: that it frames difference as a divergence from an ill-defined normal, 'natural' body. The form that this supposed normality takes is assumed to be given, as is exemplified through, for example, Toombs' descriptive of visual impairment as being unable to "see *properly"* (1988: 216, emphasis added). Even the use of the term 'impairment', which is from the Latin *pejor* meaning 'worse', defines difference through notion of a body that is lacking something (see also Reynolds, 2019). Writing from a disability studies perspective, Reynolds takes a similar position to critique Merleau-Ponty's use of the blind man's cane as an illustration of prosthetic technologies (2017). Reynolds finds Merleau-Ponty's discussion of the cane in terms of subtraction and addition of sense and the reach of the body problematic. Drawing on the account of John Hull, who became blind late in life, Reynolds argues that the cane – and blindness itself – must not be approached through the lens of the absence of sight. By conflating "corporeal alteration" with "corporeal degradation" (Reynolds, 2017: 425) we prevent ourselves from recognising that blindness is a fundamentally "world-creating condition" (Hull, 1997: xii; see also Reynolds, 2017: 425). What this means for phenomenological accounts of the body is that the experiences of people with disabilities cannot be thought of in terms as altered versions of the experiences of people without disabilities. Rather, they must be recognised as full and valid experiences in their own right. In framing the blind man's cane in terms of a substitution for ocular vision, Merleau-Ponty failed to recognise the extent to which disability pervades everyday life, instead seemingly presuming that experiences of blindness are confined to experiences of the absence/presence of sight. Blindness does not represent a divergence from a 'normal' position but is an essential component of being-in-the-world and the body's "situatedness" (after Young, 1980; see also Al-Saji, 2017). Furthermore, the 'norm' itself cannot be understood as a predetermined given but must be recognised as a normative process – something (re)produced through repetition across bodies and societies (Ahmed, 2006). With this in mind, I now turn to explore how feminist and queer theory approaches have critiqued phenomenological accounts of lived experiences in terms of gendered experiences of (im)mobility and (in)ability.

Gendered Bodies

Writing at the intersection between feminist and queer theory, Sara Ahmed offers a critique of Husserl's phenomenology for implying an "ease of movement" – whether social or physical – which produces a "mobile body" (2006: 138; see also Lindner, 2012: 206). Within this section I explore how we might understand that this mobility cannot be assumed as given by attending to it through the lens of gendered bodies and their experiences of space. Drawing on Ahmed's work, Lindner asserts that the mobile body is one "for whom space constitutes the possibility of action" and that such a body "takes up a very particular orientation towards the world" (2012: 206; see also Ahmed, 2007; 153). This is a critique which posits that mobility and ability are not merely a measure of a body's intrinsic capacity, but the capacity that body is permitted to have by the situation within which it exists. One context in which geographers have studied this in detail is through accounts of gendered experiences of fear (see for example Valentine, 1989; Brownlow, 2005). As Brownlow (2005) notes, perceived risk and the resultant fear of a space need not be correlated with actual risk, but is instead often a gendered process. Moreover, drawing on the work of Stanko (1995), Brownlow identifies that strategies for coping with fear are also gendered – most notably that women were more likely that men to adopt avoidance strategies. In other words, women perceived their ability to safely access spaces differently to men. From a phenomenological perspective, this means that the lived experience of space is contingent on the gender of the body experiencing it.

Within the field of gender studies, Young's (1980) work has sought to illustrate how depictions of women's embodied experiences and abilities failed to account for the broader context of their lives. This is an idea that others (such as Fanon, 1986 and Ahmed, 2007) have continued to develop. Per Ahmed, the ability to perform even mundane tasks is not simply a reflection of bodily ability but the "ways in which the world is made available as a space for action" (pg. 153). Thus, when the availability of different spaces is partially determined by the gender (and other identifying traits) of the bodies inhabiting it, we must recognise that the ability to act within that space is also partially determined by gender.

For those writing from these positions, the classical phenomenological accounts of writers like Husserl, Merleau-Ponty, and Heidegger overlook the differences between bodies. But that is not to say they reject phenomenology as a method, indeed these writings are phenomenological themselves. Instead, they try to rework phenomenology to engage with difference. Like Reynold's, they see the body as always already political, and so embodied phenomenological writing itself must engage in this politics. One notable example of this is Vivian Sobchack's (2010) reflection on living with a phantom limb. Sobchack, whose work is discussed at several points in this thesis, draws disability studies and feminist

theory into conversation with phenomenology to attend to her experiences of her lived body following an above-the-knee amputation. Here, phenomenology becomes a tool to attend to difference, to conceive of a sense of absence, an out-of-placeness, and a change in embodiment. It is through such accounts that phenomenologists can explore the perception and experience of body boundaries and identity. Bremer (2013) has similarly engaged with such a narrative to provide a phenomenological exploration of transgender women's interactions with healthcare in Sweden, where transgender women's experiences of their own bodies were seen to "destabilize the Swedish society's naturalized and anti-transgender ideal." Phenomenological accounts such as these engage with the politics of embodiment, and provide a valuable avenue through which the lived experiences of marginalised groups can be given a space that is often denied to them.

Attending to Difference in Archery and Postphenomenology

These discussions have sought to provide a brief critique of phenomenology's account of undifferentiated bodies. While the approaches discussed above have emerged as a direct challenge to phenomenology's perceived shortcomings in terms of its understanding of bodies, postphenomenology has sought to avoid perpetuating these aspects of phenomenology's legacy in a more general sense. The postphenomenological imperative to focus on case studies and concrete examples – as is discussed throughout this chapter – lends itself to an approach which places difference at the centre of discussion. While not explicitly a response to phenomenology's undifferentiated account of the body, postphenomenology seeks to accept difference inherent in all things. The examples discussed in this thesis – both through literature and empirical chapters – are situated within a specific context constituted of bodies, spaces, times, and relationships. As I discussed in the previous section, it is postphenomenology's ability to attend to the individuality of human-technology relations (Rosenberger, 2014) that led to my decision to choose it over Actor Network Theory as the core theory for my work.

The need to appreciate the differences between bodies is paramount to understanding skill in archery. Archers frequently talk about the idea that there is "no one right way to do archery," and this notion becomes central to much of my empirical discussions. Instead, archers seek to establish an idiosyncratic alignment, a kind of attunement between themselves, the equipment, and the range. Although there are general guidelines, the expectation is that no two archers will have identical shooting postures because no two archers will have identical bodies. Furthermore, not only are differing bodies involved from the start, but these bodies differentiate themselves through participation. As muscles build, injuries accumulate, and posture transforms, the embodied

experience of being an archer involves a process of re-orientation (after Ahmed, 2006). Given this, it is vital that my approach has the capacity to consider bodies in their individuality. The postphenomenological perspective that I introduce within this chapter provides a means to attend to difference by recognising that the specific experiences that each archer encounters at any given moment are unique.

3.3 Bridging the Postphenomenologies

Within this section I identify the two different schools of postphenomenology which are applicable here. These schools do not currently interact at any significant scale, but I propose that they can be brought into a productive dialogue. I begin by outlining each approach before providing an overview of how the rest of the chapter will work to provide a bridge which will allow ideas to travel between the two postphenomenologies without simply trying to combine them into one approach.

The term postphenomenology first came into use in 1979 when philosopher of technology Don Ihde published *Technics and Praxis.* Since then it has continued to gain prominence, inspiring others to follow Ihde's approach. Of those working in the field the most notable include the works of Rosenberger and Verbeek (Rosenberger, 2008; 2015; Verbeek, 2005; 2016; Rosenberger and Verbeek, 2015). Ihde's postphenomenology has maintained its background in philosophy of technology, where it seeks to explicate the ways in which technologies mediate human interactions with, and understandings of, the world. As I will detail in the subsequent subsections of this chapter, although postphenomenology holds its roots in phenomenology and philosophy of technology, it sharply distinguishes itself from either. Postphenomenology can most notably be differentiated from the phenomenology of Husserl by its focus on the relations between things, rather than the "things themselves" (per Husserl). Hans Achterhuis identifies three ways in which postphenomenology diverges from classical philosophy of technology, which are set out fully later. The most prominent of these changes is that postphenomenology has undertaken an "empirical turn" (Achterhuis, 2001) – likely an influence of its phenomenological and pragmatic heritage.

While this was been occurring in philosophy of technology, a separate and distinct postphenomenology (usually styled as post-phenomenology) has begun to emerge in geography. Where Ihde's postphenomenology drew on pragmatism, geographers have largely understood post-phenomenology to be a post-structuralist take on phenomenology. Within geography, the descriptor

of post-phenomenology was often applied post-hoc until recently and the works which could be described as such span multiple areas of interest including the body, landscapes, and soundscapes. It is perhaps, then, unsurprising that post-phenomenology has been described as "not particularly cohesive" (Lea, 2009b: 377) with others noting that "there is currently no clear articulation of what differentiates post-phenomenology from phenomenology … nor is there a clear set of trajectories along which such difference can be pursued further" (Ash and Simpson, 2016: 48). While part of this incoherence is internal to the disciplines – particularly geography, where it has only recently begun to gain traction (Lea, 2020) – a great deal arises from the gulf between the two approaches. For ease of clarity, I shall henceforth refer to the approach used in this thesis as 'postphenomenology' and reserve the hyphenated post-phenomenology for times I am specifically distinguishing between the geographical approach and Ihde's work. I have done this not because postphenomenology has the greater influence on my work, but because it has a more cohesive identity – something I discuss throughout this chapter – and a clearer and better establish objective. Furthermore, post-phenomenological geographies do not consistently hyphenate meaning the unhyphenated term is more common in the literature used throughout this thesis.

A postphenomenological approach will form the basis for my analysis, and as such the lack of cohesion is particularly problematic. To this end, I use this chapter to introduce the history of both approaches to postphenomenology, drawing attention to their common roots and shared philosophies. I do not present these histories as my own interpretations of the original texts, but rather as my understanding of how those texts and theories are mobilised by postphenomenologists today. As such, certain aspects are brought to the fore, while other histories are largely untouched. I then turn to what I see as the key divide between the two schools of postphenomenology, at least for the context of this study – intentionality. I then reflect on the similarities and differences, and how I have brought ideas from each together to form the approach used in this thesis. Once I have drawn the two schools of thought together, I provide accounts of postphenomenology in practice, introducing some of the key methods to the approaches and some vital vocabulary along the way.

The overall aim for this chapter is to produce a framework in which both approaches to postphenomenology are compatible. As a geographer with an interest in technology, both geography and philosophy of technology have a lot to offer. With this framework laid out, I shall use it to weave together the other threads of this literature review and to structure an informed methodology.

3.4 Essentialism to Existentialism

Phenomenology has existed in many guises throughout history, but it gained prominence in the twentieth century through the work of Edmund Husserl, oft referred to the father of modern phenomenology (Ihde, 2003). Husserlian phenomenology was informed by Kantian notions of transcendentalism, and Husserl was known to use the terms 'phenomenology' and 'transcendentalism' interchangeably. Transcendental phenomenologists, following Kant and Husserl, "work towards a universal conception of being" which studies "a more impersonal, less located form of experience" (Lea, 2009b: 373).

The "universal conception of being" described by Lea was informed, at least in part, by the essentialist influence on Husserl's work. In *Experience and Judgement,* Husserl defines the essence of an object "of a certain kind" as being "that without which an object of [that] kind cannot be thought" (1973: 341). Following this logic, all objects 'of a certain kind' must therefore have inherent traits which are shared with all other object of that kind. The essence of an object or being, therefore implies that there are a priori, ubiquitous truths to being. Many geographers have taken a critical view of Husserl's for precisely this reason. Similarly, postphenomenologists such as Verbeek are critical of the notion that objects can so easily be considered 'the same' as other objects which share their physical properties (2005). Writing in 1978, just a year before Ihde's postphenomenology began to emerge, Derek Gregory criticised Husserl's work as being unable to explain "precisely how the transition from the empirical to the transcendental level was to be effected" leading him to conclude that it "is not a practical philosophy and that it has little to offer the social sciences" (pg. 163). He further criticised phenomenology more generally for its use of a universal body (Lea, 2009b). These critiques of essentialism, while stemming from geography, are answered through the empirical approach of Ihde's postphenomenology. This demonstrates that, at their core, there are some important shared values between the approaches.

For Ihde, the divergence of phenomenology and postphenomenology originated within the departure from this transcendentalist approach (De Preester, 2010). However, the transition was not an immediate leap. Instead there was a gradual shift through an existentialist approach to phenomenology seen in the works of philosophers such as Heidegger and Merleau-Ponty. Heidegger's phenomenology was predominantly a phenomenology of technology, making it a natural influence on much of the postphenomenological research carried out by contemporary postphenomenological philosophers of technology, such as Ihde, Rosenberger and Verbeek. Verbeek's first major publication, *What Things Do* (2005)*,* provides an account of Heidegger's phenomenology of technology as a direct precursor to Ihde's postphenomenology. This account stipulates that Heidegger viewed reality as being relational and that only through relations with human beings could 'the concealed' elements of the world be revealed (ibid). Heidegger, thus, shared Husserl's idea that there was a heart to objects

which we aimed to get at. However, Heidegger's departure from essentialism was in his claim that the essence of technology must be thought of as a verb as it refers to how technology is present, rather than what it 'is' (ibid). This claim was one of the first indicators of an emerging move to an existentialist take on phenomenology, a movement which was further developed by Merleau-Ponty in the 1940s, roughly during the middle of Heidegger's career.

Much like Heidegger, Merleau-Ponty's philosophy was not completely distinct from Husserl's. Despite opposing the idea of the transcendental ego, Merleau-Ponty still believed that humans were transcendental in the sense that they gave meaning to things (Baldwin, 2004: 11). Ihde notes that it was in Merleau-Ponty's shift away from subjectivity and towards an embodied approach that the transcendental ego began to disappear from phenomenological accounts, stating that "bodies cannot be transcendental, they are existential. While there lingers, but to a much lesser extent, notions of subjectivity in Merleau-Ponty's work, it is clear that his primary emphasis was placed upon embodiment." (2003: 11). Merleau-Ponty's focus on embodiment is similarly influential within geographical research that has been described as post-phenomenological in nature (for example Wylie, 2005; 2006; Simpson, 2009).

Although Heidegger influenced Merleau-Ponty's writing, key differences do exist between their approaches. The most pertinent departure for the development of postphenomenology was Merleau-Ponty's view that when we interact with the properties of an object their properties are as they appear, and not something concealed or hidden beneath our experience (Merleau-Ponty, 2004). Merleau-Ponty interrogates the importance of the interconnectedness of these properties. Inspired by Sartre's account of the relationship between a food and its properties (Sartre, 1943: 186) he writes of a lemon's taste, colour and shape: "it is not clear how each of these qualities or properties is bound to the others and yet it seems to us that the lemon is a unified entity of which all these various qualities are merely different manifestations" (Merleau-Ponty, 2004: 59). In a later discussion of honey Merleau-Ponty observes that "to say that honey is viscous is another way of saying that it is sugary: it is to describe a particular relationship between us and the object or to indicate that we are moved or compelled to treat it in a certain way… Honey is a particular way the world has of acting on me and my body." (ibid: 62). Later, I discuss the significance of the claim that objects compel bodies to act in certain ways, but within this context the importance of Merleau-Ponty's insight is that the properties of objects emerge within relationships, rather than exists a priori, waiting to be discovered. For Simpson (2009), the turn towards viewing properties as being emergent and relational is a key feature of geography's post-phenomenology. Simpson makes claims based on his own work as a geographer with an interest in the post-phenomenology of street performance, as well as the interpretations of Merleau-Ponty and Husserl that inform his work.

Contemporary postphenomenology, particularly following Ihde, has continued to distance itself from essentialist thinking. Many of the philosophers of technology who subscribe to Ihde's theories attribute this to the incorporation of pragmatism into phenomenological thought (De Preester, 2010). Ihde himself claimed that postphenomenology could be explained through the 'simple equation' "postphenomenology = phenomenology + pragmatism" (2012: 117; 128). Zwier et al (2016) has claimed that the anti-essentialism found in Ihde's postphenomenology is the predominant consequence of pragmatism's influence, specifically the pragmatism of James Dewey (De Preester, 2010). However, Ihde has stated that his reading of Dewey's pragmatism had a broader effect than this, and that in making use of pragmatism postphenomenology's claims are "never about the absolute foundations of reality or knowledge, and never about the "essence" of an object of study. Instead, postphenomenology's claims are posed from an embodied and situated perspective, refer to practical problems, and are empirically orientated." (Rosenberger and Verbeek, 2015: 1). The appeal to recognising the context in which things emerge is echoed within geography's postphenomenology but is also representative of geographical thought more broadly. Despite post-phenomenology's appreciation of emergence, Dilkes-Frayne and Duff note that, unlike other approaches, post-phenomenology is also well situated to appreciate notions of endurance and repetition (2017), themes that are pertinent to this work's study of skill.

De Preester believes that the role of essences has been taken by Ihde's notion of multistability (2010) which, as discussed in the next section and then in more detail later, suggests that objects may have multiple, stable trajectories and forms depending on the context of the interaction with them. Thus, while essentialist thinking has declined in the phenomenology's transformation into postphenomenology, its heritage can still be found. The resulting postphenomenology, however, is one which sees things within the contexts of the encounter and as adapting to shifting environments.

3.5 'technologies' and 'Technology'

In the previous section I looked at the shift out of essentialism and toward an existential phenomenology, here I discuss the, related, movement away from viewing technology as a single, monolithic thing toward the case-study-based approach seen in postphenomenology. In short, this section explores phenomenology's empirical turn. To achieve this, I turn to postphenomenology's second ancestry – that of philosophy of technology.

At the turn of the century, Dutch philosopher of technology Hans Achterhuis identified three main differences between classical and contemporary philosophy of technology (2001). Within this chapter I approach and unpack each of these differences in turn. The first proposes that classical philosophers of technology produced theories based on the idea that technology was, in some sense, a unified occurrence. He believes that this fuelled their fears that all technological artefacts were following the same trajectory – towards an alienating future of automation. Ihde, who subscribes to Achterhuis' theory, distinguishes between this idea of "technology uberhaupt" (literally "technology in general") and the concrete examples of technology "within a lifeworld" (Ihde, 2009: 22) that he mobilises by referring to the former as "Technology (with a capital 'T')" (Ihde, 1993: 34). Secondly, classical philosophers often displayed romantic or nostalgic tastes, something Heidegger is particularly frequently criticised for (e.g. in Ihde, 1993: 103-115). Verbeek attributes this to their transcendentalist style of thinking leading them to understand technology in terms of its conditions of possibility, namely "the functional organization of society" (2005: 45). Achterhuis' final difference was that contemporary philosophy of technology has undertaken an 'empirical turn,' a claim supported by Ihde (2009) and Zwier et al (2016). Here I used the work as Karl Jaspers as an example of the first difference, that of Heidegger to illustrate the second and finally I look forward, to emerging postphenomenological work to demonstrate the third. These examples are meant to be purely indicative, and so are by no means exhaustive.

Karl Jaspers exemplifies the stance taken by many classical philosophers of technology in his belief that technology was a threat to "the possibility for human beings to exist authentically" (Verbeek, 2005: 34-35). In his early work, starting with *Man in the Modern Age* (1931), Jaspers conceives of technology as jeopardising humanity's ability to exist as unique individuals. To situate his work within the socio-economic and political context in which he wrote, Jaspers lived during a period of growing automation and mass-production. The notion of large-scale manufacturing of identical items became analogous for his fears for the future of humanity. His predictions of a technologized mankind were ones of decreasing independence and increasing autonomy and the dystopian mode in which he cast his assertion was hugely influential. Verbeek aptly summarizes Jaspers' early view of technology as being that "technology suffocates human existence" (2005: 17).

Verbeek, one of the few (if not only) postphenomeonlogists to engage directly with Jaspers' work, is critical of his assumptions that mass-produced technology cannot garner sentimental value (2005). For Verbeek, technologies have meanings beyond their material components. One could, therefore, reasonably feel a unique attachment to a specific mass-produced artefact, but not to any other copies of it despite their identical physical composition. This critique draws on the postphenomenological view that technology "cannot be reduced to design functions" (Ihde, 2002: 106). A position which

argues that the symbolic and meaningful construction of a technological artefact cannot be said to have been finalised alongside its material construction. Rather, it continues to develop throughout the artefact's 'life', changing use and value alongside its context. The idea that things can have a meaning greater than their physical presence is once again echoed by geographers. One variation of this is the postphenomenological idea of haunting in geography. The notion of haunting suggests that things' absences can have a (nonmaterial) presence of their own, a presence which cannot be designed in but is nonetheless exerted by the object.

Returning to Jaspers, his later work shows a growing ambivalence towards technology. Contrary to his early fears he asserts that technology would always be subservient to man as it cannot generate its own goals (Verbeek, 2005). While negating his dystopian predictions, in many respects this change of stance moved Jaspers further from a postphenomenological philosophy of technology. By stripping technology of agency, Jaspers was reinforcing the notion of a subject-object dualism, which both schools of contemporary postphenomenology oppose through their antifoundationalist and post-structuralist influences (see Ihde, 1993; Ash and Simpson, 2016).

Heidegger, who was writing at much the same time as Jaspers, was similarly criticised for his dystopian view of technological development. However, Heidegger was also notably nostalgically of past technology, so much so that Ihde dedicates an entire chapter *in Postphenomenology: Essays in a Postmodern Context* (1993) to deromanticizing this nostalgia. For Heidegger, technologies fall into two different categories. First there are archaic technologies, such as wooden bridges, which are seen to 'gather' the world in a certain way without changing it and so are posed in a positive light. The second, modern technologies, conversely are framed as negative because are perceived as turning the world into a resource. Heidegger notably uses the example of a hydroelectric dam on the Rhine as turning nature into "something at our command" (1972: 297). Heidegger was similarly scornful of typewriters, claiming that "the typewriter snatches script from the essential realm of the hand – and this means the hand is removed from the essential realm of the world" (1982: 118). Here Heidegger briefly touches upon the idea of technological mediation which is at the heart of Ihde's postphenomenology. Nonetheless, he remains unable to see the multifarious potentialities enabled by such mediation, and so maintains his dualistic notion of good and bad technologies. Heidegger's opposition to modern technology stems from his fears that it renders nature a resource – potentially one day including humans. Feenberg (1999) is critical of Heidegger's fear, stating that his approach is so abstract that he cannot discriminate between "electricity and atom bombs". Thus, he falls afoul of the same problem as Jaspers, only distinguishing himself with his romantic nostalgia for technologies of the past.

Turning to the third difference, Verbeek identifies that the contemporary philosophers of technology (sometimes referred to as empirical philosophers of technology within Dutch literature) have opposed methods which reduce technologies to the conditions of their possibility and discuss those conditions as though they were the technologies themselves. Instead, they research specific technologies to explore how the context of an artefact's use alters the way it emerges in a relationship (2005), a claim that has fundamentally influenced the methodology of this study. Ihde believes that this transition to empirical accounts is a necessary step away from thinking of a "unitary, determined single destiny to technological development" and toward one which embraces "a multistable and diverse and ambiguous set of multiple directions whose ends are probably not predictable" (Ihde, 1993: 34). Elsewhere, Ihde emphasises the importance of recognising the "multidimensionality of technologies" and states that doing so is "a step away from a high altitude or transcendental perspective." (Ihde, 2009: 22).

The concept of multistability, introduced in the above quote, describes the multiple trajectories technologies have. It recognises that function of a technology is, in part, produced by the context within which it is found and so can take on different meanings within different settings (Kiran, 2015). In recognising the multistability of objects postphenomenology becomes necessarily empirical, as transcendental theories and generalisation would lose much of the richness the postphenomenological method can provide. As multistability is a central component to both postphenomenology and this thesis a later section is dedicated entirely to exploring how multistability is used and critiqued.

In summary, postphenomenology has embraced an empirical turn. In doing so it has differentiated itself from phenomenology and classical philosophy of technology by developing an appreciation of the shifting nature of technology. A postphenomenology of technology is one which recognises that technologies emerge, and are used, within a wider praxis and so cannot be understood in isolation. This is a theme shared between geography and philosophy of technology. Each of the schools of thought recognises that importance of viewing things in context and see objects and people alike to be emergent phenomenon.

3.6 Intentional Subjects and Object Imperatives

So far in this chapter I have demonstrated that the postphenomenologies of geography and the philosophy of technology both have their roots in the same schools of thought. By working through

these and indicating their shared ideologies I have endeavoured to demonstrate that they are not as distinct as has been indicated elsewhere (see, for example, Ash and Simpson, 2016). This, however, has not been to suggest they are not independent or individual, for they are, and each has its own specific focuses and strengths. Rather, it sets the groundwork to bridge the two postphenomenologies – not to eschew difference and unite them as a single postphenomenology, but merely to establish the possibility for compatibility, and to bring them into a productive dialogue. However, to truly overcome the perceived differences between the two approaches I must first attend to the issue of intentionality, which has been described as a major point of divergence between the two (Ash and Simpson, 2016; Moran, 2000). Within this section I use Alphonso Lingis' notion of the imperative to demonstrate that intentionality need not constitute an irreconcilable difference, but can instead be seen as a useful tool for talking about human-technology (or human-human and technology-technology) relations.

Intentionality refers to "the proposition that an experience is an experience of something" (Ash and Simpson, 2016: 53). This directedness of action, it is argued, would require a pre-existing intentional actor – a subject to govern over the object. This means that for intentionality to exist not only must subjects be ontologically distinct from objects, but the subject must have primacy. It is this issue, more specifically, which geographers oppose, and critics perceive Ihde as supporting. However, Ash and Simpson do note that Ihde's postphenomenology has moved away from the standard concept of intentionality (2016), instead it has been reconceived of as being interrelational (De Preester, 2010). Through the shift towards an interrelational thinking Ihde's postphenomenology, following some later phenomenological work, contends that the subject and object are not readily differentiated, in much the same way that geographical post-phenomenology does. Where phenomenology held that subject and object were always already intertwined (Verbeek and Rosenberger, 2015), postphenomenology has taken this a step further. Ihde expresses the view that subjects and objects are not merely intertwined but actively co-shape one another (Verbeek, 2005). This is a claim echoed within geographical post-phenomenology, where Wylie's (2009) work has been described as an example of "how subjects and objects ontologically (rather than simply sociologically) co-constitute" (Rose, 2010: 141).

This ontological co-constitution of subject and object necessitates a conceptualisation of the 'things' of the world as being non-neutral. That is, they cannot be seen as inert or static – they both evolve with the world and shape the way the world evolves. Such a perspective resists a conceptualisation of technology as a passive participant to an intentional subject. This view is drawn, in part, from the shared roots in Merleau-Ponty's phenomenology. In the words of Merleau-Ponty, "the things of the world are not simply neutral *objects* which stand before us for our contemplation. Each one of them

symbolises or recalls a particular way of behaving, provoking in us reactions" (2004: 63). The influences of Merleau-Ponty's claim are evident in Ihde's call for us to study artefacts "as part of a human-technology pairing" (1993: 33). For Ihde, the use of technology not only changes our capacities in the moment of use, but by expanding the possibilities available to use technology can shape the way we approach future problems: "we invent our technologies, but, in use, they reinvent us as well" (Ihde, 2007: 243; see also Hayler, 2015; Hasse, 2013). Rosenberger, a former PhD student of Ihde's, uses the example of the Mars Orbiter Camera (2008) as an empirical example of this in contemporary science and technology research. Rosenberger argues that imaging technologies make it possible to experience things which would otherwise be imperceptible, such as electromagnetic radiation outside of the visible light spectrum. The discoveries made through such technologies guide future scientific progress, changing the ways in which we approach future problems. While this example focuses on ocular technologies, the statement is equally applicable to other forms. Ihde claims that technologies promote or evoke distinct ways of undertaking a task (Verbeek, 2005) – a claim which speaks to Merleau-Ponty's – but can never fully determine action. I believe that when Ihde speaks of technologies as having an "implicit user's manual" he is underestimating the agential vitality of those objects. As I now use geographical postphenomenology to argue, objects can determine our actions much more freely than this suggests.

Despite demonstrating that Ihde does acknowledges the non-neutrality – and therefore, implicitly, agency – of objects, intentionality remains problematic. Geographical postphenomenology pushes for us to think of more-than-human experiences. In Lea's (2009b) entry in the *International Encyclopaedia of Human Geography* for postphenomenology she describes postphenomenological geographies as extending "experience trans-humanly…taking in the inhuman and nonhuman." Far from being directed from a human actor, experience "is a creative force distributed across bodies and worlds" (pg. 373). Simpson's postphenomenological geographies of sonorous presence (2009) directly attends to this issue by arguing that sound is far more than simply listened to; it has a much broader array of affective dimensions with which intentionality is not compatible. In reflecting on this, Simpson notes that it "suggests a disagreement with Ihde's (2007) phenomenological work on listening and sound. Listening is *not* always a 'listening to', but rather a 'listening with'." (pg. 2570, emphasis in original). The concept of acting with, rather than on or through, will become a key theme throughout this thesis, particularly in the third empirical chapter. It is also a concept that Ihde's students have already shown an amenability towards. Verbeek expands intentionality to say that "what the world 'is' and what subjects 'are' arises from the interplay between humans and reality" (Verbeek, 2008: 13), a statement markedly shifting away from the primacy of subjects. Similarly, in this more recent collaborative work with Rosenberger, Verbeek establishes that intentionality does not have to be unidirectional, it is "no

longer a bridge between subject and object but a fountain from [which] the two of them emerge" (Verbeek and Rosenberger, 2015: 12). This is where the work of Alphonso Lingis can be introduced.

Using this foundation I intend to work in the concept of 'the imperative', drawn from Lingis' phenomenology, to produce an interpretation of intentionality which is not subject-centric and thus does not establish a hierarchy in which objects are afforded a lower ontological status than subjects. Lingis' phenomenology is Husserlian in many regards, and so at times veers into transcendental thinking. However, the imperative is not one such moment, nor is it reliant on this thinking, and so remains compatible with the ideas discussed so far. Lingis begins his thesis by arguing that "philosophy of the mind has failed to recognize the way perception *responds to directives"* (1998: 3, emphasis in original). This is not entirely true, as indicated earlier, Merleau-Ponty expressed a similar belief. However, Merleau-Ponty's emphasis was not quite as poignant as Lingis'. Lingis continues to argue that perception is comprised not of "reaction and adjustments nor intentional and teleological acts, but responses" (Lingis, 1998: 4). Thus, what might have been perceived as an intentional subject is rendered subservient to the objects they believed themselves to rule over, it is, he states, "by the imperative one finds oneself commanded to be master" (pg. 200).

With this thinking, Lingis neatly turns intentionality on its head. Object imperatives take primacy over intentional subjects. It is now the things of the world which drive our actions, not vice versa. However, my intention is not to completely reverse intentionality by arguing that the imperative is the more accurate depiction of agency. Instead, I argue that they can, and do, exist side-by-side. Thus, I am proposing that we can reconcile the issue of intentionality by considering it to be one half of a dialogue, a dialogue at the heart of all actions. Actions, therefore, at always *inter*actions. Neither comes first, there is no issue of primacy, but as Verbeek and Rosenberger described, there is only a fountain from which all can emerge.

By considering intentionality and the imperative as two components of the same dialogue, I remove the implications carried by the term 'object' stripping it back to give it the same meaning as 'thing' within this work. I also expand on and specify what is meant by an 'interrelational' intentionality in the postphenomenology of philosophy of technology and provide an opportunity to bridge the two approaches to postphenomenology. I have also established that objects are non-neutral things, a claim that is commonplace in both geography and the philosophy of technology. This framework – of non-neutral objects which can draw others into action – becomes the theoretical basis for the concept of 'working with' discussed empirically in chapter four. By maintaining intentionality yet removing the need for it to necessitate subject primacy (which philosophers such as Verbeek and Rosenberger (2015) already reject) I have drawn the two approaches to postphenomenology into dialogue under a

single framework. With this achieved, I now move to briefly conclude my section on reconciling postphenomenological/post-phenomenological approaches and re-iterating what they offer.

3.7 A Unified Post(-)phenomenology?

I am not the first to argue that the limitations of post-phenomenology can be mitigated by bringing it into conversation with another (post)phenomenological approach; Kinkaid (2020) has recently used critical phenomenology to discuss intentionality and the subject in phenomenology in much the same way I have done with Lingis' imperative. Efforts such as these indicate that post-phenomenology is not yet a fully developed, cohesive area of study. Lea's (2009b) first entry on post-phenomenology in International Encyclopaedia of Human Geography highlighted the lack of identity, something that was echoed by Ash and Simpson (2016). However, by the release of the second instalment (Lea, 2020), a stronger identity had emerged. Even so, some still believe that the "varied and sometimes conflicting array of theorists" put to work in post-phenomenology prevent it from developing as a "coherent" and "clearly defined" school of thought (Roberts, 2019: 545). Throughout this thesis, I use post-phenomenology as a way of sensitising Ihde's postphenomenology to geographical modes of enquiry. In particular, while Ihde's postphenomenology lends itself to the study of relationships, it is the geographical post-phenomenology which digs into how those relationships are experienced. This is exemplified best in the parts of this work that look at skill; the post-phenomenological perspective that experience is distributed across a more-than-human system (Lea, 2009b) informs my work much more than the postphenomenological view which leans towards human primacy and thus fails to consider objects' experiences.

A core trait I have borrowed from postphenomenology is the emphasis on studying specific instantiations of technology, a result of its empirical turn and pragmatist heritage. While this does not explicitly go against post-phenomenology's tradition to do so, the geographical approach is much more open to more abstract theoretical studies (such as Ash, 2020). Both pragmatist and post-structuralist literatures feature throughout the thesis, and I would not identify my work here as belonging exclusively to either school. However, Ihde's philosophy of technology heritage is reflected in the interests of this thesis, as well as influencing the line of enquiry I take.

I would not wish to claim that I am writing a new thread of post-phenomenological enquiry, per Roberts there are likely too many of those already (2018). Instead, I am trying to open up existing approaches to conversation with other forms of enquiry to enable post-phenomenology to act as the

same kind of 'background hum' (Lorimer, 2008) that nonrepresentational theory once did and, to some extent, still does. One way that post-phenomenology is already doing this is by informing research methods (Ash and Simpson, 2019; Ash et al, 2018; Rossetto, 2018), something postphenomenology has also done (Verbeek and Rosenberger, 2015). In this thesis, both approaches to postphenomenology informed the choice of method, as I discuss in chapter six, and the conceptual tools that I have chosen for my analysis. I now move to consider these tools, which are drawn from postphenomenology but renegotiated to remain relevant to a geographical context.

3.8 Postphenomenology in Practice I: Multistability

As introduced earlier, a postphenomenological framework is one which appreciates the ways technologies shift shape as they are used in different contexts. This is approached through the idea of multistability. As a concept, multistability originated within Ihde's (1993) work on images where it was used to describe the way a viewer's position – physical, social, psychological etc. – could alter the way the image was perceived. One famous demonstration of this can be found within the Necker Cub (Figure 5). This optical illusion shows the basic skeleton of a cube. However, if the viewer is to focus on corner A, and then shift their gaze to corner B the image appears to rotate. Ihde suggests that further images can also be made with the cube, beyond the original two. For example, if one imagines the outermost lines as a hexagonal hole, then the central square (between A and B) becomes the body of an insect with the connecting lines becoming its legs.

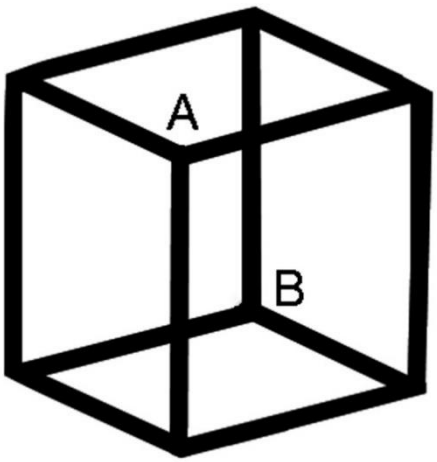


Figure 5 Necker Cube

Ihde uses the term 'variation' to describe each possible form of the image and adopts Husserl's term 'variational analysis' to describe the "brainstorming" process of finding such variations (Verbeek and Rosenberger, 2015: 27). Rosenberger expands Ihde's vocabulary, suggesting the term 'stabilities' as an alternative term of the variations (2008). Within Rosenberger's language, the term 'hermeneutic strategy' refers to the 'story' which makes a possible variation of an image, and 'multistability axis' to describe the basis upon which something becomes open to multiple interpretations (ibid). In the example of the Necker cube, one might say that a hermeneutic strategy is the point one's eyes focus on (i.e. A or B). A potential multistability axis could be called a *reading axis* or *orientation axis,* as it is possible that audiences from cultures where texts are read right-to-left look at A (and the associated variation) before B, and vice versa for people from cultures were texts are right left-to-right. Multistable images or artefacts can have several multistability axes, and observers can have a diverse array of hermeneutic strategies. These hermeneutic strategies can also be communicated between people to share perspectives and explain interpretations.

It is not only images which are multistable, but other abstract sensations (tastes, sounds, smells) and physical artefacts too. Per Ihde, all artefacts can be "recontextualised and repurposed" (2002: 106), they can "take quite different shapes in different contexts" (Ihde, 2007:13). This is particularly important to this thesis as it aims to recognise the role of context in how the properties and uses of an artefact emerge. Ihde draws on examples of technology transfer between explorers and native communities to show how objects demonstrate multistability. He tells the story of a group of Australian gold prospectors encountering New Guinean Highlanders for his first two illustrations. Upon their encountering of the Australians – their first encounter with people outside of their own community – the Highlanders immediately recognise the steel knives as being superior to their own

stone tools. However, Ihde notes, it was not until they experienced rifle-fire as a response to attempting to steal the knives that they paid much attention to the prospectors' guns at all. Ihde attributes this to a lack of equivalent praxis. That is, the highlanders had no equivalent to a gun through which they could conceive of the gun's superiority, unlike the knife. This then demonstrates that objects are understood within a praxical gestalt (or, perhaps, through a hermeneutic strategy), formed of same physical, social and psychological factors important in viewing Ihde's image (1993). The multistability of the knives was seen predominantly in their material construction, rather than application as the praxis was the same. The guns, however, were not understood by the highlanders and so were dismissed as unnecessary originally (until conflict performed the role of sharing a hermeneutic strategy[5]). Another example Ihde uses to demonstrate how multistability can be the result of different applications is through the highlanders' utilization of discard sardine cans as ornaments for elaborate headdresses. So, while the knives' multistability axis was one of material properties, the guns' and tins' axis were of practical application.

The third example Ihde uses is the difference between the monohulls of European ships and polyhull of Pacific Islanders. Ihde notes that these examples are important because both existed (and continue to exist) simultaneously, despite the hermeneutic strategy/praxical gestalt having been shared. This demonstrates that multistability is not about a lack of awareness or understanding, but of context more generally. Stabilities are not necessarily 'more correct' or 'better' than one another, but more suited to their contexts. In the context of this thesis' interest in archery this can also be applied to bow styles. There are three main constructions of bow – longbow, compound, recurve (although there are less common styles, such as horse bow, beyond this) – but they are not considered to be replacements of or advances on one another. In contemporary archery the different styles develop along their own semi-independent trajectories.

There are situations where the multistability of an image or technology can produce ethical dilemmas, for example within the medical industry. Friis (2015) states that at least half of medical errors are perceptual, as medical staff are required to interpret multistable images such as x-rays for the purpose of diagnosis. Verbeek (2008) considers a specific example of this by looking at the ethical issues surrounding ultrasound. Verbeek notes that ultrasounds, through the revealing of diseases and disabilities, prompt difficult ethical questions surrounding pre-emptive treatments. Although it would be impossible to completely remove the possibility of misinterpretation, Rosenberger (2014) offers a partial remedy to this issue. Rosenberger criticises the postphenomenological approach as not going far enough, stating that if one is intending to "do anything more than level a counterpoint against an

[5] A less violent example of the role of training in forming hermeneutic strategies can be found in Hasse (2008)

overreaching account, then more is required… After variational analysis there should be a variational cross-examination where particular stabilities are contrasted" (pg. 381). Such a cross-examination could look at *why* each multistability occurs, rather than just observe that they do occur. Within this thesis this idea will be applied alongside the notion of feedback loops, drawn from cybernetics, to suggest that variational cross-examination can be used to develop artefacts which are better adapted to their context by recognising which traits draw them to the desired stability.

As a final point, it is important to recognise the limits to multistability. As Ihde notes "multistability is not the same as neutrality. Within multistability there lie *trajectories*, not just any trajectory, but partially determined trajectories." (2002: 106, emphasis in original). It is, perhaps, here that multistability differentiates itself from the notion of the 'multiple' found in Science and Technology Studies. Taking, for example, de Laet and Mol's study of the Zimbabwe Bush Pump (2000) there is a clear contrast between the "fluid" nature of the multiple and the "stable trajectories" (De Preester, 2010) of multistability. For the latter, and for this study, objects are seen as being able to shift shape but each of these shapes, when taken in isolation, is stable. And so multistable objects are conceived as having horizons, however distant, and perhaps only limited to the imagination and ability of the user (Ihde, 1993) but horizons nonetheless. Although the idea of multistability was developed within philosophy of technology, it shares many principles with a geographical approach. The notion of things having dynamic existences which alter according to their contexts is frequently used and geographers have previously mobilised the idea of the multiple (Mol, 2002) (see, for example Simon and Randalls, 2016) to show this. A series of topologies outlined in papers by John Law and Annemarie Mol (2001) and John Law and Vicky Singleton (2005) have been used to a similar effect (see, for examples, Sage et al., 2014). Multistability, then, is not truly an idea unique to postphenomenology, but merely a specific way of mobilising a commonly consider concept.

3.9 Postphenomenology in Practice II: Technological Relations

In 1979 Ihde published his first thesis on human-technology relations. The ideas he presented in *Technics and Praxis* have seen significant refinement and application over the past four decades. In this section I explore the four forms of technological relations he introduces, identifying those of pertinent to this thesis and building upon them with ideas from geographical thought.

Ihde's first two forms of relation are categorised as "relations of mediation" (Verbeek, 2005). Within each of these the role of the artefact is one that changes one's experience of the world. As discussed

earlier, Ihde's theories still rely on technological intentionality and that can be seen clearly in how he poses the mediation relations. As before, I intend to adapt the theories to remove the necessity for intentionality so as distance my work from subject-object dualisms. I do this primarily by substituting the unidirectional arrow Ihde places in his 'formulas' for the relations with a bi-directional arrow to recognise that these actions are interactions. These formulas are intended as illustrative tools, or ways of thinking about relations. They are not, therefore, wholly accurate accounts of interactions between people and technology. This is in part because it is the relations themselves, rather than the components of the relation, which are the object of interest. As such I refrain from critiquing Ihde's homogenising presentation of 'I', 'technology' and 'the world' throughout.

I begin with embodiment relations. This kind of relation is the most commonly discussed in literature on tool use, and in phenomenological thought more generally. It focuses on a sense of incorporation whereby when I act, I act *through* the artefact. One may think here of any technology from telescopes to telephones. Merleau-Ponty famously uses the examples of a woman with a feather in her hat and a blind man with a cane, and these examples were greatly influential for Ihde. Just as Merleau-Ponty claims that "[the woman] feels where the feather is just as we feel where our hand is" (1962: 143) we can expand our senses through an ever-growing number of technologies. As stated, this type of relationship is the most frequently discussed within the literature, but also potentially the most controversial in its claims. The extent to which technological artefacts do become incorporated has been the sources of much debate (see, for example, Hayler, 2015) as have the requirements for such incorporation. This question remains at the heart of the thesis, both throughout the literature review chapters and the empirical work. For now, it is sufficient to understand that it is through embodiment relations the artefact becomes 'transparent'. This is to enable the 'acting through' (Verbeek, 2005; 125) which is perceived as necessary. The formula for embodiment relations, once expanded to become what one might call an *inter*-relation of mediation is as follows[6]:

(I-technology) ⟷ world

The formula shows that the relationship between the components of the left – for example, a person and their eyeglasses – exists as distinct from the interaction with the world at any given moment. While the person/glasses pairing cannot exist outside of the world they can move within it as a single unit. Thus, while an unstated actor could engage with the world without the involvement of man or glasses, no actor could engage with person or their glasses without engaging with the other as well –

[6] As with all these formulae, Ihde's originals only had a single-sided arrow (pointing from left to right). The double-sided arrow is an adaptation based around the role of object imperatives and interactivity discussed elsewhere in this chapter.

the two are encountered as one. The original formula, with a unidirectional arrow, was dismissive of the agency of the world. In the example of the glasses-wearing person this is especially apparent; after all, sight is the experience of light hitting our eyes. We do not choose to see (except in not closing our eyes) nor what we see or how those sights influence us.

The formula also presupposes that the person is already technologized. Whereas they may have, for example, only put on their glasses in response to being presented with an aspect of the world he needed his glasses to see, such as an object on the horizon. Alternatively, one might consider the example of a (visual) telescope, as Ihde often does. One does not carry a telescope and coincidentally view the stars, but the decision to access a technology as a mediator comes after a pre-existing relationship with the world (or stars) is dismantled. In other words, an unmediated relation may pre-exist a mediated one, but the first relation must be deconstructed to introduce the mediating component. Once this has occurred the relation between viewer and mediator becomes established before the inclusion of the viewed. It is important to understand that these schematics only illustrate snapshots of dynamic interactions and are not constraining principles.

A hermeneutic relation, Ihde's second form of mediation, similarly supposes that we are interacting with the world via a technological artefact. However, in this instance the artefact does not become transparent. Instead we interact with the artefact *in lieu* of the world. The artefact translates some aspect of the world for us to understand. While embodied relations require technology to become transparent, hermeneutic relations require it to become *coherent* so that it can be read. In such cases the aspect of the world that is being translated would be otherwise inaccessible for us. Ihde's discussions of radio telescopes (1993) would be one example, Verbeek also uses a thermometer to demonstrate this (2005), but I find the most detailed example in Verbeek's (2008) interrogation of the ethics of sonograms**.** In this paper, Verbeek identifies the hermeneutic relation which is formed through ultrasound technology. The relation is hermeneutic because it requires us to read an interpretation through technology, we cannot directly sense the sound waves ourselves any more than we can the radio waves or quantified temperature in the previous examples. Importantly, the process of reading opens up the possibilities of misinterpretation through the multistability of the image, as was discussed in the previous section. While multistability exist in all these relations, it can be seen most prominently in hermeneutic relations precisely because of the need for something to be 'read'.

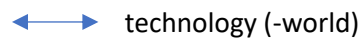
The schematic formula for hermeneutic relations can be written as:

This is roughly the opposite of embodied relations, as it is the world which is joined to the technology This relation can also co-exist with an embodied relation. For example, through an embodied relation with a telephone one may speak to a friend in a distant location. However, a passing thundercloud, possessing a greater propensity for signal reflection, may reduce your signal and impede the call. As one cannot directly experience radio propagation occurring but can 'read' or measure it through the signal bars of a mobile phone this is a form of hermeneutic relation in which the world or environment is acting on us.

In both forms of mediation, the technology not only magnifies but also reduces other elements: "as with all revealing there is also concealing" (Ihde, 1993: 5). While a telescope magnifies the stars and planets it also magnifies the bodily movements of the user, thereby reducing stability, and limits the viewable area (Ihde, 1993). Simpson (2009) discusses how someone wearing headphones is unable to hear the music of a busker, showing how they reduce one's ability to perceive certain aspects of the wider world. It is through similar logic that certain technologies can be seen to have alienating effects within specific contexts. While a mobile phone might increase the range over which someone can communicate, by offering distraction it may reduce the sociability within the immediate area. Kiran (2015) proposes that we can consider technological mediation as having different dimensions, of which magnification-reduction is only one. Kiran calls this the epistemological dimension as they shape the knowledge we have about the world, but additionally notes that there are existential (revealing-concealing), practical (enabling-containing) and ethical (involving-alienating) structures. It is through these structural dimensions that we can perceive the effects of technology. So, while a mobile phone may be enabling in its long-distance communication it can also be described as alienating without being contradictory.

Beyond these two models of technological mediation, postphenomenology proposes two other forms of relation. The first, alterity relations, describes direct interaction with a technology. In this relation the technological artefact is not a means for engaging with the world, but the target of interaction itself. Verbeek (2005) explains that in alterity relations the technology is encounter as a "quasi-other". It becomes an 'other' because of the style of the relation, but remains 'quasi' because "they can, of course, never be present as a true person… a technology is never a genuine other" (pg. 127). Verbeek's statement establishes a hierarchy which places humans above technology. Further discussion comparing horses to automobiles makes clear that he would situate nonhuman life between humans and technology in this hierarchy. This imbalance is deeply problematic for geography, which has tried to cultivate an appreciation for nonhumans – living and non – within the networks we act in (e.g. Bingham, 2006; Ash, 2017). As established earlier, the ontology of my postphenomenology is one in which artefacts are actors equal to, if not the same as, human actors. As such, alterity relations, in the

context of this thesis, are those in which the principle interaction is between one actor and another as distinct entities. Therefore, while embodied relations see technology coupled with the user and hermeneutic relations see the technology coupled with the world, alterity relations are those in which the technology is 'free-standing'. The schematic formula is:



The final relation is a background relation. In these relations we are not directly interacting with technology or the world. Instead technologies "shape the context of our experience in a way that is not consciously experienced" (Verbeek, 2005: 128). One might wish to describe these as 'artificial environments' as they often alter one or more elements of the world we experience without ever making themselves present. A familiar example would be of central heating. While we have a hermeneutic relation with the central heating as we adjust it, the ongoing relation would be a background one. In his explanation of background relations Verbeek describes the position of these technologies as one of "absent presence" – their presence is one characterised not terms of transparency, as in embodiment relations, but invisibility. As some geographers have observed, absence is not a simple lack of presence, but is itself a present sensation. These 'spectral geographies,' as they may be called, have interrogated issues of memory, haunting and loss (Wylie, 2007; Foreman, 2014), but here can be applied in a more mundane way. In doing so, background relations are not simply seen as having an absent presence but also a present absence. The implication of this is that background relationships demonstrate that technologies are not confined to their material presence, something I discussed in section 3.4. To take, instead, the example of Wi-Fi which: while functioning (is present) it remains unobserved (is absent in the eyes of the user). However, when the system breaks (is absent) this is experienced and draws attention to itself (it becomes present). Due to its complex (non)presence Ihde's schematic formula does not depict a direction for action in either direction and so does not need adapting. The formula would therefore remain as:

I (-technology/world)

Within this section I have presented and modified the schematic formula for human-technology-world relations which are common amongst postphenomenological philosophers of technology. These formulae are tools of analysis, rather than analyses themselves. As such, it is important to recognise that the different relations may coincide with one another, each being a single – but not necessarily distinct – component of a larger interaction between actors. My focus within this thesis draws on all four relations but focuses predominantly on embodied and background relations as the linked

concepts of transparency and invisibility are central to this thesis' analysis of incorporation. In addition, the alterity relation will be considered as an alternative to embodied relations to suggest that transparency is not always guaranteed – nor desired – when skilful interactions between people and technology occur. This section has also provided further examples of postphenomenology 'in action'. In doing so it has attempted to demonstrate the importance of empirical application to postphenomenological theory.

*****

To conclude this chapter on postphenomenology, I have outlined how both approaches can be applied simultaneously to create a postphenomenological framework with a greater focus on the experience of technological relations. Postphenomenology provides the thesis with an overarching philosophical structure and direction. It is through this structure that the other literatures introduced in subsequent chapters can be woven together, and through which the methodology is constructed. The next chapter looks at a diverse array of literatures focused on extension to the (physical and non-physical) body, but all of the theories it introduces can be framed in terms of postphenomenological relations in order to generate a process/relation-oriented perspective of the lived body. Through this, and the relations introduced within the previous section, postphenomenology sets the groundwork for challenging the limits to the body. This is a theme which will continue to be explored throughout the rest of the thesis.

4. Performance Beyond Bodies

4.1 Introduction

The rise of feminist and cultural geographies towards the end of the twentieth century produced a renewed interest in the experiences of the body. For geographers, the body draws attention through its interdependence with space and time: the body is not, and cannot be, understood as fixed, contained, or separated from its context (Abrahamsson and Simpson, 2011). The absence of clear limits – or, perhaps, the apparent ability to exceed its presumed limits – prompted questions of where we may claim the body ends. In 2009, a session at the *Association of American Geographers* (AAG) conference sought to explore the question and, along with the resultant special issue in *Social and Cultural Geography* (Fannin, 2011; Wilson, 2011; Green, 2011; Barratt, 2011; Abrahamsson and Simpson, 2011), noted that attempts to define limits had variously focused on the "biological, phenomenological, psychological, social, [and] material" dimensions of being (Abrahamsson and Simpson, 2011: 333). The result has been the production of a myriad of ways of understanding, defining, and capturing the body and its boundaries. Stemming from this debate is the critical question how something might cross, extend, or otherwise manipulate, the boundaries to become a new part of the body. Ultimately, this question lies at the foundation of this thesis, and this chapter speaks to that through a review of the ways in which academics – within geography and beyond – have conceived of the body as a bounded entity. Through an overview of literature concerning extensions to and transformations of the body, I seek to highlight the continuing debates over where the limits may lie and how we can map or model alterations to them. This is a necessarily multi-disciplinary overview; different fields understand the body, and therefore its boundaries, through their own inflections. Thus, this element of the thesis cannot be solely understood by situating it within geography but must look to broader discussions.

I begin by looking at the body as a distributed entity. Within geography, discussions of skilled practice overflowing the limits of (human) bodies (Laurier, 2013; Lea, 2009a; Livingston, 2008) has seen a resurgence through the post-phenomenological approaches introduced earlier (Lea, 2020; 2009b). These theories predominantly draw on Ingold's anthropological work and depict skill as being a product of relationship and interactions rather than residing in an individual (Ingold, 2000). I use these arguments to demonstrate the plasticity of the body and point to the importance of understanding more-than-human communication, for which cybernetics, as introduced in chapter five, provides a

basis. These ideas are built on throughout the empirical chapters of the thesis as well as the latter half of this chapter.

The second section shifts to explore debates on tool-use and extensions to the body. It uses De Preester and Tsakiris' (2009) postphenomenologically informed criteria for incorporation – that an object must be transparent in use and must be imbued with a sense of body ownership – to consider what it means for a technology to be incorporated. I suggest that theories which take such an approach can be described as fitting a 'model of incorporation', which I will critique for its humanistic assertions through my empirical work, predominantly in chapter nine. This section draws on literature on tool-use and prosthetic limbs to draw comparisons between the two. It also questions the use of peri-personal space (PPS) as a way of determining a sense of body ownership. Overall, this section aims to highlight that literature on tool-use frequently locates control in the 'human' part of human-technology relations, a perspective that must be addressed and nuanced to appreciate object agency. Together, the chapter as a whole situates the thesis within a multi-disciplinary line of enquiry which questions how humans and technologies interact through debates around body boundaries.

4.2 Distribution and Ecologies

More than a decade before geographers at the AAG puzzled over the limits of the body, Clark and Chalmers had posed much the same question, albeit with a slight inflection emphasising their background in cognitive psychology: "where does the mind stop and the rest of the world begin?" (1998: 7). Clark and Chalmers saw how people utilized and manipulated the environment around them to perform 'cognitive' tasks and argued that there was little reason to distinguish to between cognitive processes that occurred within the mind and quasi-cognitive process that were offloaded onto the environment (ibid). Like many forays into debates about body boundaries, this evokes the cybernetic notion that distinction between people and the tools they use are "not communicationally meaningful" (Bateson, 1972: 251). However, these discussions have a broader focus than tool-use, further including the framing of the environment, other people, and non-tool artefacts. I consider three approaches: extended cognition, Clark and Chalmers' answer to their earlier question; taskscapes (Ingold, 2000) and skillscapes (Hunt, 2018); and Downey's (2008b) application of scaffolding (Wood et al., 1976). Each of these ideas has some presence in geography, despite emerging elsewhere, and each is used throughout this thesis. In this chapter I will primarily focus on extended cognition as it has the broadest applications of the three, with task/skillscapes and scaffolding primarily focusing on skilled practice, and because the latter approaches will explicitly revisited

through empirical examples later whereas extended cognition has more of a background or foundational presence and a sets historical precedent for studies on non-physical extensions to the body.

Extended cognition is founded on what Chalmers later called the 'parity principle' (2008: xv) – the idea that processes that appear to be cognitive can be treated as such even when they occur outside of the traditional cognitive 'boundaries' of the brain. Through this principle they argue that any given cognitive process should be "delimited by functional relationships among the elements that participate in it, rather than by the spatial colocation of the elements" (Hollan et al., 2000: 175). Studied examples included re-arranging Scrabble tiles to identify potential words (Kirsch, 1995), pen and paper annotation in long multiplication (Clark, 1989), and the airline cockpit (Hutchins and Klausen, 1996). The use of the word 'extended' refers to the spatial reach of the cognitive processes and is not intended to imply a 'superior' form of cognition. To avoid these concerns, some choose to refer to it as 'distributed cognition' (Cowley and Vallée-Tourangeau, 2017; Stanton, 2014; Hutchins and Klausen, 1996). Although extended cognition was the original term (Clark and Chalmers, 1998), I will used distributed cognition here as it more readily alludes to the nature of the theory as proposing that cognition can be 'spread out' and dispersed. Regardless of the term chosen, the theory "extends the reach of what is considered cognitive beyond the individual to encompass interactions between people and with resources and materials in the environment." (Hollan et al, 2000: 175) – a claim which bears a striking resemblance to Lea's (2009b) assertion that post-phenomenological geographies sought to "extend experience trans-humanly … [allowing] the analytic focus to be decentred from and extended beyond the human body, taking in the inhuman … and the nonhuman" (pg. 374). It is this emphasis on distribution of agency that makes the theory pertinent to my study.

Clark uses the term 'wideware' to describe those aspects and objects which may not be conventionally considered to be cognitive. Through our reliance on "external props" (Carolan, 2008: 418), wideware takes the form of a cognitive scaffolding which supports decision making, memory, calculation, and a wide variety of other cognitive processes. Clark proposes the idea of cognitive scaffolding by building on the notion that Alzheimer's sufferers maintain a notably higher level of functioning when in familiar spaces (Baum, 1991). For Clark, this indicates the importance of contextuality and an ability for individuals to seek and create ways to use the environment to their benefit in cognition as well as physical ways. Finding insight in Baum's study, Clark attends to the importance of the "proper context" of an actor (1999: 13) making particular use of the example of a bluefish tuna. Bluefish tuna, he observes, exploit eddies, currents, and pressure gradients to turn sharp corners and accelerate well beyond what their bodies would otherwise be capable of. In the absence of naturally occurring phenomenon which it can utilize, the bluefish tuna will create its own. He concludes that the "real

swimming machine … [is] the fish plus the surrounding structures and vortices that it actively creates and maximally exploits" (ibid). Rammert draws on the language of Latour to call these "hybrid constellations" and argues that we should consider them to be a particular kind of collective actor (2008: 2). However, Ingold (2020) has critiqued the Clark's notion that it is not the fish that swims, but the 'fish-in-the-water,' stating that it is too "mechanical" (pg. 11) a depiction of the realities of both fish and water. Ingold points towards the individuality and vibrancy of each – fish and water – to dispute such clean representations of their interactions, and diverges from Clark's mechanical and computational language to favour notions of "whirl" and "vortex" (pg. 12) to more aptly capture chaotic interactions. When I return to Ingold later, I discuss the agency of the environment in more detail, but it is an area in which distributed cognition appears insufficient, with Clark's theories more often presenting the environment as a largely passive tool, which points towards possibly benefits of further geographical exploration in the area.

However, broader explorations of distributed system do consider how environments shape action. Hollan et al. (2000) claim that people off-load cognitive effort onto the environment whenever it is practical, so it is unsurprising that distributed systems frequently come to be without intention. That is, individuals may create (or participate in) distributed cognitive systems without reflecting on what they are doing. Decorating and inhabiting a house is one such example. Although not directly drawing on distributed cognition, Shove and Southeron's (2000) description of one participant's cooking coevolving with their use of a freezer provides insight into how concepts akin to wideware may be applied in social sciences to understand how technologies shape decision making. They describe how, to make efficient use of the freezer, a participant began to batch cook meals in bulk and freeze them for later use. Furthermore, they reorganised the kitchen to create a more efficient workflow for the kinds of cooking that the freezer required. This distributed system is one in which the cognitive effort involved in choosing, preparing, and cooking a week's worth of meals was, through the mediating role of technology, concentrated into a single instance (see also Southerton, 2003). Unlike the prosthetic technologies which I describe later, those in a distributed system are not physically imbricated in the body, but rather frame decision making processes and are "implicated in the structure and reproduction of practice and hence in the choreography of things and people in time and space" (Hand et al., 2007: 608). Although not directly deployed in the thesis, it is worth noting how this framing has been manipulated to encourage desired behaviours. Nudge theory, popularised by Thaler and Sunstein (2008; 2014), seeks to manipulate what it calls "choice architecture" (Thaler et al., 2013)- a term which bears more than a little similarity to Clark's 'cognitive scaffolding'. Despite the relatively recent surge in popularity, nudge theory first arose in the cybernetic work of James Wilk following a 1993 lecture *The Art of the Nudge.* Like the other theories discussed in this chapter, nudge theory is

predicated on the idea that processes traditionally thought of as occurring internally, such as decision making, are in fact embedded in and partially determined by our environments.

Before moving to focus more on discussions of environments, I consider a specific application to what we might understand as a distributed system: scaffolding. Scaffolding was first proposed by Wood et al. (1976) as an approach to understanding how tutors aided tutees by managing parts of the task which are beyond the student's current ability. This allows the student to confront individual aspects of a task without being overwhelmed. This can be essential for tasks which cannot be readily decontextualized, such as practices where participants learn by doing. Archery is one such example, and I return to this through my empirical work in later chapters where I use it to explore the role of instructors and the range in training new archers. However Downey's (2010; 2008a; 2008b) investigations into capoeira, a dance-like martial art, provide insight here. Downey notes that a particular advantage of scaffolding is that it enables practitioners to engage "directly in the sorts of tasks performed in normal skilled action, rather than simplified tasks, exercises or other learning activities (such as listening to lectures or explanations" (ibid: 207). In the same way that distributed cognition allows us to understand how individuals "offload" (Hollan et al., 2000) cognitive effort onto the environment, scaffolding allows us to understand how it may be offloaded onto more skilled individuals. This provides clarity in the context of skilled performance as it provides room for the coaches and instructors to be situated within our interpretation of the performing system. Where scaffolding particularly distinguishes itself from discussions of distributed cognition is the implicit emphasis on restriction rather than extension. In Downey's interpretation of capoeira, he draws on Bernstein's (1996) idea of "degrees of freedom." For the novice capoeirista, these degrees of freedom are excessive and beyond their control so they must rely on the instructor as a "vicarious form of consciousness" (Bruner, 1986: 123; Downey, 2008b) until such a time as they have developed. Thus, the instructor is not simply there to expand possibilities but to restrict and regulate them. The approaches used to do this – including gesture and body orientation – may be considered as wideware (Alač, 2005). However, through distributed cognition models, scaffolding does not require an imbalance in skill or expertise. Hutchins and Klausen's (1996) study of distributed cognition in an airline cockpit explores how repeating instructions back between members of the crew and air traffic control acts as an error-checking system. By providing an opportunity for internal (between the crew) and external (with air traffic control) confirmation, these processes identify the crew as a distributed collective actor akin to those described previously. Hutchins and Klausen also draw attention to the importance of inter-, and more-than-, human communication, an idea that is present but largely implicit in other discussions. This further reiterates the potential for a cybernetic language for understanding how distributed systems work.

I return now to the anthropological work of Ingold. As previously noted, Ingold criticises Clark's wideware and distributed cognition for being too mechanistic (Ingold, 2020) and instead favours language which promotes more lively and vibrant depictions of human-technology and human-environment relations. Ingold argues that skill "*demands* an ecological approach" to study (2000: 353, emphasis in original). Ecology, here, not only contrasts the rigid 'scaffolding' of distributed cognition but evokes the spirit of Bateson's cybernetics-inspired anthropological work *Steps to an Ecology of Mind* (1972). This is not a coincidence – Ingold cites Bateson as an influence, particularly for thinking beyond the skin as a limit to the mind (Ingold, 2000: 3)[7], along with a second 'ecological' author: Gibson. Like Bateson's work, Gibson's *The Ecological Approach to Perception* (1979) further rejected the prevailing belief at the time that humans experienced the world through internalised representations (see also Hirose, 2002). Following this theme, Ingold proposes the 'taskscape' (1993) as "an array of activities that weave in and out of one another" (2017b:17) just as a landscape is an "array of related features" (2000: 195). Ingold himself later disputes the need for the taskscape (2017b), arguing that his more recent concepts, such as the meshwork (2011; Klenk, 2018), render it redundant. However, Hunt (2018) draw on cultural geography's understandings of place to reconsider the taskscape to propose a skilled-performance-specific version she calls the skillscape. Through this model the skilled performance is no longer understood as "objectified, person-centred knowledge" (Payne, 2018: 107) but instead recognises that skill emerges out of a web of relations (Patchett and Mann, 2018). By disembodying and dis-locating skill it becomes an important topic of geographical interested (ibid) as it is distributed across space (Pacault and Patchett, 2018) and throughout time (Ingold, 2018). Ecological approaches to skill have shown that alterations to the environment can change a performer's perception of what is achievable, such as bouldering matts reducing the risk and making more difficult walls climbable (Barratt, 2011). This can also be inversed – less dynamic environments render skilled activities repetitive (Eden and Barratt, 2010) further indicating the environment's role in framing practice. This relationship perpetuates as practices cultivate bodies and environments better suited to the practice (Lewis, 2000) which in turn changes the array of available actions considered achievable (Hirose, 2002).

As taskscapes, skillscapes, and distributed systems of all kinds shift and morph, those within them must be able to detect and respond to such changes. Therefore, skilled practitioners can be said to develop a "skilled vision" (Adams, 2018: 39; see also Goodwin, 2000; Laurier, 2013) which allows them to detect minor variations and adapt their behaviour accordingly. This skilled vision is not inherently

[7] The use of ecological approaches is also prominent in geography, notably Thrift (1999), Jones (2005), Murdock (2006) and Simpson (2013)

a visual process[8], Patterson, for example describes how touch might be used (2009) and Payne (2018) and Simpson (2009; see also 2017) respond to primarily auditory prompts in their studies of music whereas in chapter eight I describe a multisensory awareness. In each case, although one sense gains primacy and is often the focus of attention the others are not ignored. Sudnow (1978) identifies this through his exploration of learning jazz piano. Although the focus of his journey of skill development is on his hands and sense of touch, he does note the role of his own hearing too. Hearing, for Sudnow, acts to reassure his sense of touch. It confirms and calibrates his senses to further his immersion into the practice. The skillscape becomes a multisensory experience. Within the context of archery, this skilled perception can and does take many forms. One example can be found with aiming during outdoor shoots. While aiming might be thought of as a traditionally visual process, other senses are drawn on to make judgements as to how wind, rain and temperature will affect the arrow. I apply these theories in more detail in chapter eight, where they are used to explore how archers adjust to changing environments.

Throughout this section I have sought to identify a trend of disputing the limits to the body. This trend gained traction towards the end of the twentieth century and, although explicit references are rare, shows cybernetic influences at its heart. Skill has been a particular focus for such studies, as it is for this thesis, and so the literature discussed so far also speaks to the post-phenomenological attitudes of geography which view skill as extended beyond human bodies (Lea, 2009b). In breaking down assumptions about the limits to the body, the emphasis shifts away from the archer to what Clark (1999) would call the 'archer-in-their-proper-context'. Situating this study amongst the rich heritage of ecological approaches thus emphasises the importance of the range, equipment, and broader environment – physical, social, and emotional – in the skilled practice and therefore this thesis. While this section has sought to look outwards to the body moving beyond its physical limits, I now turn to look at the other side of this – tools and technologies being brought inwards by a process of 'incorporation.'

4.3 The Model of Incorporation

Haraway's 1985 publication of *A Cyborg Manifesto* (republished in 1991) may not have been the first piece of literature to attend to the transformative nature of the human body, but it was nonetheless

[8] Although this is often the focus in the literature. As Patterson (2009) identifies Western literature often prioritises sight over the other senses. While there is a significant push to find a place for touch and, more recently, sound, in academia smell and taste remain underappreciated.

the start of a turn towards what later became known as 'cyborgology'. While much of Haraway's cyborg was a metaphor for cultural and social imbrication, her claim that "any object or persons can be reasonable thought of in terms of disassembly and reassembly; no 'natural' architecture constrains system design" (1993: 283) is a cornerstone for the study of malleable bodies and speaks back to the idea's cybernetic roots, something subsequent work has been criticised for failing to do (Laughlin, 1997). The image of the cyborg represents a "hybridised organism," one which "(con)fuses man and organisms, animal and apparatus, physical matter and non-physical information" (Zylinska, 2002: 5). As such, the cyborg is far from a mere merger of machine and bodies. It is a multi-layered and ever-evolving entanglement that is woven into the identities of each component, thus placing the boundaries of individual beings into question. The more-than-human nature of the cyborg both implies and requires that such boundaries be diffuse and dynamic. But the cyborg is a metaphor, or conceptual tool, for study of a much older phenomenon: the use of prosthetics.

The oldest known biomedical prosthetic is a wooden and leather toe unearthed in an Egyptian tomb and believed to date back to 600BC (Finch et al., 2012); but the term 'prosthetic' itself didn't enter the English language until the 18th (Wills, 1995) or 19th (Parry, 2017) century where it has long been used to describe a specific type of tool-use that includes, but is not limited to, artificial limbs. Holmes (2012) points to the diversity of the approaches in which tools are viewed as extensions of the body, noting its presence in literature (e.g. Melville, 1851), philosophy (Lotze, 1885), neurology (Head and Holmes, 1911), sociology (McLuhan, 1964) and neuroscience (Iriki et al., 1996). To which I would further add sports science (Thorndahl and Ravn, 2016), cognitive psychology (Clark, 1999), cybernetics (Wiener, 1948), anthropology (Messinger, 2008) and now geography. This popularity can be attributed to what De Preester calls a fetishization of the prosthetic (2011) which has led some, such as Sweet (2016), to argue that conflating biomedical prosthetics with 'prosthetic' tools is problematic because it can hide the voices of biomedical prosthetic users. Elsewhere, I more directly attend to the term prosthetic and why it is inappropriate to describe the types of relationship I discuss. Here, however, I use the term for biomedical prosthetics (such as artificial limbs, dentures, or contact lenses) and as the kind of relationship one forms with them. This includes were that relationship may exist with a tool not conventionally thought of as a prosthetic, where appropriate. The categorisation of certain tools as prosthetics stems from the way their relationship takes shape in use. Despite the breadth of disciplines and approaches discussing tool-use as prosthetic extensions of the body – including "appropriation" (Gapenne and Declerck, 2009) and "phenomenological osmosis (Leder, 1990) – there is an overwhelming trend towards what I come to call 'model of incorporation' approaches. These interpretations are predicated on the belief that we possess the ability to, intentionally or otherwise, shift the perceived body/artefact boundary (Black, 2014) through the body "continually unfolding"

(Carolan, 2008: 414). In this section I outline a specific set of requirements for an object to be considered 'prosthetic', which are taken from De Preester and Tsakiris (2009) and explore how these requirements unfold in practice. Through this explore the idea of incorporation through a range of examples of tool-use and prosthetics studies.

Following the language of postphenomenology, the incorporation of a tool or prosthetic into the body marks a shift from the 'quasi-other' of alterity relations to the 'quasi-self' of embodied relations (Ihde, 1990). But De Preester and Tsakiris (2009) distinguish between an incorporated prosthetic and an embodied tool, reserving the former for biomedical prosthetics. They do this by placing two criteria on an artefact for it to be considered part of the body. The first is that it must become transparent, withdrawing from conscious thought. This idea can be traced back to Heideggerian notions of 'ready-to-hand' technology (1954) and is a common theme in incorporation approaches. In contrast to a present-at-hand technology, ready-to-hand technologies are acted *through* rather than on. This criterion is shared between incorporated and embodied technologies. The major distinction comes from De Preester and Tsakiris' second requirement: that the technology change the user's body schemata. De Preester argues that Merleau-Ponty's work is vague about the distinction between incorporation and extension (2009; 2011) and draws the line at whether the technology is included in the user's sense of body ownership. Both of these criteria place certain inflections on the processes of incorporation and are worth exploring in more detail.

Technological transparency once again speaks to Bateson's (1972) claim that there can be no meaningful barrier drawn between a tool and tool-user. Indeed, the principle is closely associated to the ecological approach discussed above – the two sometimes being combined (e.g. Hirose, 2002) – as it disputes the conceptual importance of body boundaries in the face of more-than-human communication. It is through transparency that tools and prosthetics are seen to "melt" (Murray, 2008: 119) into the body. Importantly, the transparency of an incorporated artefact is not just a perceived transparency, but an experiential one (Gapenne and Declerck, 2009). For Carijó et al. incorporation is only achieved when acting through these technological reconfigured relations can be done "as directly, effortlessly, and fluently as one's own body" (2013: 687),[9] a requirement echoed by Cole and Derry's conflation of the term "unmediated" with "natural." When Merleau-Ponty described the blind walker's cane as being "no longer perceived for itself" (2002: 165) the perception he describes to is arguably more than a simple matter of visual perception, but rather refers to the unobstructed flow of communication between the tool and its user. This is what Anderson (2012) calls

[9] This comparison is problematic in its assumptions of the capabilities of the body which, in reality is not necessarily able to act "effortlessly" or "fluently." However, the intention here is that the distinction between the ability to act and sensation of acting with or without the technology should be minimal.

'convergence'. Anderson distinguishes convergence from an assemblage through the requirement that components to not simply "connect" but see their boundaries give way in a more fluid process. The processual nature of convergence arguably lends itself to better describing the flows of interactivity between the body, tool, and environment as they work to actively co-shape each other. Anderson specifically states that any 'thing' taking part in a convergence can only ever be partially understood when viewed in isolation – in other words, it cannot be perceived for itself. Such a blurring of boundaries can situate technologies as mediating our interactions with the world – per Ihde's formula for embodied relations discussed earlier. Dant and Wheaton provide an example of this with windsurfing, where the surfer must respond to wind and water through the board and sail (2007). Cole and Derry describe this reconfiguration as a set of "new structural relations" (2005: 11) which change our ability to act and the options available to us (see also Massumi, 2002). Where completely alien, these new structural relations can be difficult to navigate. One prosthetic user who was born without a left hand remarked that, once provided with a prosthetic, it remains difficult to "think left handed" (Murray, 2004: 20). However, these changes are not automatic – possession of a tool alone appears to be insufficient to trigger a reconfiguration, instead the wielder must anticipate its use (Witt et al., 2005). Furthermore, incorporation is not a pre-requisite for this, as studies have shown that technologies enable reconfigurations regardless of whether they are incorporated (Hand et al., 2007) in ways more akin to the ecological approach discussed previously than incorporation, meaning this alone is insufficient as a criterion.

In their shaping of relationships artefacts are not neutral (Ihde, 2009; Verbeek, 2005; Michael, 2000). Rather, they demonstrate their own forms of agency which is partially amplified by their perceived transparency. That is, if a tool modifies our experience but remains unnoticed in terms of conscious awareness then it can be difficult to distinguish between those decisions and acts brought about due to its influence and those that are not. For this reason, Hayler says that when we speak of the skilled use of tools we must speak of the "body *augmented* by the equipment" (Hayler, 2011:51-2; see also Hayler 2015, emphasis in original). What Hayler describes here is a complete withdrawal of the technology into the body and subsequent reshaping of the possibilities available to it. Gapenne and Declerck (2009) argue that we can think about this as two mechanisms which, while distinct, are practically indissociable: an internal *incorporation* of the tool into the body and an external *reorganisation* of the environment as it is perceived according to the 'augmented' potential of the body (see also Barratt, 2011). However, Witt et al. (2005) found that the provision of a tool which assisting in reach (such as a rake) altered the perceived distance between a user and the object when the rake-assisted-user intended to reach for it. This suggests that the user's perception of distance was partially framed by the perception of the ease of achieving a task over that distance, and therefore

could be reshaped along with the capability. This is in keeping with other similar studies (Witt et al., 2004; Proffitt et al., 2003). However, this may go beyond mere perception, as shown by Mark (1987), who attached blocks to the shoes of participants and observed their attempts to acclimatise to the increased height. Although participant eventually adapted to their augmented heights – suggesting incorporation, or at least embodiment, had been achieved – they continuously overestimated the height of the blocks themselves, indicating that the reframing is experiential as Gapenne and Declerck (2009) had reported. Furthermore, the technological reshaping extends to a physical reshaping of the body as it adapts to the use of a tool. Prolonged engagement in the skilled use of a tool will likely result in biological changes, such as muscle development. Rickly (2016) describes this a co-creation of the practice by the performer and the performer by the practice, however these changes can diminish the practice ceases (Rossiter, 2007).

However, technological mediation does not solely extend an individual's abilities. For Ihde and those using his postphenomenological approach, any technology which magnifies or extends the body also produces an equal instance of demagnification (Ihde, 1993). While a telescope can see further than the human eye, it is restricted to a smaller area on which it can focus. Similarly, it is vulnerable to instability as movements to the telescope itself are equally magnified. Hayler describes a similar process, naming it "visceral insulation" (2015). He borrows the term from anthropologist Timothy Taylor for whom it referred to a movement away from the "rawness of nature" (2010: 98). Visceral insulation is one instance of demagnfication which proposes, in a way almost reminiscent of Jaspers, that technology detaches man from nature. However, Hayler is by no means the technophobe Jaspers was, but he recognises that technologies do indeed mediate our interaction with the world and in doing so often mute certain aspects. Visceral insulation may be desirable in certain instances as it is readily associated with ease and comfort, but Lewis (2000) argues that for rock-climbers and other extreme sports practitioners the removal of risk equates to a removal of pleasure. Thus, even where we can see the insulation as an enhancement (e.g. as protection) it can be experienced negatively because of its transformative nature. One historical example of this is Heidegger's notorious dislike of typewriters, which he felt rendered the act of writing unrecognisable as compared to writing by hand. Thus, we must be alert to the fact that the technological reconfiguring or practice brought about by mediation can change practices to the extent that it is not only experience *differently* but experienced *as different*.

The issue of transparency also rises to the fore in its absence. Incorporated technologies can be rejected by the user when something causes their transparency to cease. Once again, Heidegger's work on tool-use underpins much of the current work. For Heidegger, a technology's ability to become ready-to-hand can be impeded if it is conspicuous, such as through damage; obtrusive and non-

functioning; or obstinate, where it is merely an obstacle which must be overcome (1954). Further reworkings of Heideggerian philosophies of tool-use have expanded these through empirical work. Hayler identifies that incorporation is process that occurs over time and through repeated use (2015) allowing the tool-user to acclimatise to their augmentation. As such, sudden and unexpected changes may draw attention back to the tool, even in the case of unexpected success (ibid). In Murray's work on biomedical prosthetics, he refers to this as the "temporal process" of managing a "good fit" (Murray, 2004: 29). Later I use my empirical work to explore how the cybernetic concept of noise can be used to understand the breakdown in incorporation, and how attunement (Merchant, 2011; 2012) can be used to maintain skilled performance. However, even technologies which we would anticipate being incorporated can draw attention to themselves without failing in their purpose, calling into question Heidegger's reasons for failure. For Michael (2000), the shoe is an incorporated technology, but the shoes of Barratt's climbers are notoriously tight-fitting to the point of being painful (2011a). Despite pain being undesirable, the benefit of tight shoes – namely the added stability – outweighs the cost. What this means for incorporation is not immediately clear. One possibility is that, as De Preester and Tsakiris (2009) argued, not all technologies are incorporated. This would mean climbing shoes are merely extensions of the body's sensorium, and thus pain would not inherently preclude effectiveness. Alternatively, it can be interpreted through Ihde's magnification/demagnification principle, with pain being part of the trade-off.

There is, however, a third option not discussed in the literature but that will be developed through my empirical chapters – that technological failure is only failure insofar as the technology is defined by its human uses. A less anthropocentric, more vibrant materialist viewpoint would be that this is simply a form of technological communication which can be understood through cybernetics. Such a position would be difficult to reconcile with incorporation more broadly as it would dispute the importance of any merger between humans and technology in favour of seeing more-than-human communication as inevitable. This would mean that what is being described by transparency is an easing of the flow of information across a more-than-human system rather than the actual withdrawal of the equipment from conscious awareness. Having discussed some of the details of transparency and what they imply for human-technology relations, I now turn to consider the second of De Preester and Tsakiris' requirements: the change in sense of body-ownership.

At the heart of the issue of the body schemata is the question of how one can know one's body is one's own (Waldenfels, 2004; see also Tsakiris, 2010), thus theories that trouble any easy distinction between bodies, such as those discussed so far, also call into question whether external objects can be drawn into body schemata. For Cardinali et al (2009) it is possible when a tool or prosthetic changes the "somatosensory representations of intrinsic properties of the body morphology" (pg. 478). Yet, as

natural morphological changes such as aging do not inherently create a sense of dissociation, a certain level of plasticity is implied. Within the context of tool and prosthetics use, which is the focus of this thesis, the property most in question is called peri-personal space (PPS). Peri-personal space refers to the area around the body which is seen as immediately accessible. As many studies on PPS centre around the hand (Galli et al., 2015), this is usually framed as the extent of an individual's reach. Claims that incorporated technology extended PPS have been tested extensively by neuroscientists (Holmes, 2012), perhaps most notably in Maravita and Iriki's (2004) paper on the changing patterns of neuron activity in Japanese macaques as they became skilled in using a tool to reach food. The study shows that, over time, the area made accessible by the rake was processed by the part of the monkey's brain that processed peri-personal space. They, and many others following their research (Telakivi, 2020; Heersmink, 2020; Clark 2008; Gallagher, 2006), posit that this suggests that the rake has been incorporated and the body extended. This contradicts De Preester and Tsakiris' assertion that the body schemata cannot be extended, only restored through prosthetics, and thus incorporation is impossible in any other case. In part, this debate is complicated by the question of what we consider to be extended and how. For example, in disputing Malafouris' (2008) claim that blind person's stick is incorporated, Chakrabarty (2015) proposes that the stick is a *perceptual prosthesis* but a *limb extension*. Whether De Preester and Tsakiris would accept this is unclear; however, Chakrabarty's position that the stick is only an incorporated prosthetic when considered as restoring eyesight, and not when extending the arm, appears to fit within their requirements.

However, this is predicated on the assumption that there is, in fact, something in need of restoring. Thus, I now to turn studies of limb loss, which provide a rare possibility to study PPS shrinkage (Canzoneri et al., 2013) and subsequently the ability for it to be recovered as well as what this might mean for the body schemata. While studies have demonstrated that PPS does shrink following a limb amputation (ibid) the experience of 'phantom limb syndrome' calls into question whether this is tied to change in the body schemata. Phantom limb describes the (normally temporary) experience of a limb which is no longer present, often due to medical intervention or injury. It is experienced by 80-100% of amputees (Chahine and Kanazi, 2007), some of whom entirely believe the limb remains present – and experience it as such, including being able to describe its posture and movements (ibid). The phantom limb haunts the body, often inflicting pain (Nikolajsen and Jensen, 2001), and can be attributed to the body "attempting to maintain a certain bodily equilibrium in the face of continual changes" (Weiss et al., 1999: 35). In other words, the phantom limb seems to indicate that regardless of PPS shrinkage, the body schemata remains intact – at least for the duration the phantom limb is experienced. Sobchack (2010) provides a phenomenologically rich account of her experience of phantom limb syndrome in which she vividly describes the presence of its absence. For Sobchack, as

with many experiencing phantom limb, the absence of her left leg does not preclude its ability to feel. The joint presence of the limb in the body schemata and absence of the limb in the physical body opens potential lines of enquiry for spectral geographers' work on absence and presence (e.g. Wylie, 2009; Moran and Disney, 2019) to be applied to the body which are beyond the immediate scope of this work. It also provides a critique for the conflation of PPS and body schemata. Further evidence for this comes from Galli et al's study in wheelchair use and embodiment (2015). They found that, while wheelchair users experienced the wheelchair as embodied, the extent to which they had to focus on manoeuvring it further drew their attention to their immediate surroundings and did not result in increased PPS. In the case of both phantom limb syndrome and wheelchair use the body schemata appears dissociated from the extent of PPS, which disputes its potential as a metric for verifying whether incorporation has occurred. The implication for this, in the context of this thesis, is that contemporary accounts of tool-use which rely on notions for incorporation fall short of fully explaining the process as experienced by tool-users.

The ability to identify incorporation is further troubled by the role tools can play in a person's sense of self. De Preester (2011) argues that the sense of loss that we feel when we stop using a bike is limited (see also Botvinick (2004) on cutlery) and that this is evidence it is not incorporated and that by extension nor are other tools. However, elsewhere De Preester and Tsakiris (2009) observe that 'specialised tool-users' may feel a sense of "wholeness" from their tools (see also De Preester, 2011). This contradicts De Preester's exclusion of the bike, as sports equipment and musical instruments are both provided as examples of technologies that evoke such reactions (ibid; Thorndahl and Ravn, 2016). De Preester proposes that this may be due to their ability to extend expression (2011) but appears uncertain and suggests that instruments may require a new category altogether. Throndahl and Ravn's (2016) analysis of rope skipping leads them to propose that it could be due to the close association between technological practices and identity, a view echoed elsewhere (such as Butryn and Masucci, 2009). Indeed, under a postphenomenological approach the practitioner is defined by their relation to the practice, with Zwier et al. (2016) stating that a woodcutter is constituted as such through the relationship with the tree and axe. This is echoed in some geographical literature, as Hunt (2018) claims that a tool can only be considered as such when placed in relation to other things and fields of activity. In both of these cases the claim is that there is a co-construction between tool and tool-user which further frames the requirement of De Preester and Tsakiris (2009) as placing too much emphasis on the biomechanical/physical dimensions of the relationship and not enough on the social/communicative aspects. This highlights the need for research to further consider communicational limits to the body in human-technology relations, as this study does through its focus on affect and the lived experience.

Yet, regardless of the metric used to determine incorporation, rejection can always occur. A participant of Murray's (2004) research on prosthetic limbs aptly summed this up claim that "fitting a dead thing to your live body is and always will be an imperfect process" (pg. 12). Even in the case of artificial limbs, as this participant indicated, the prosthetic may not be incorporated as part of the body (De Preester, 2012), as even when a prosthetic triggers the activation of neurons normally associated with "body-part-centred receptive fields" this can be insufficient to create a feeling of ownership (Botvinick, 2004: 783). This reasons for this are not always well understood and research can provide contradictory results, which is one reason why alternative approaches need to be considered. The use of the rubber hand illusion (RHI)[10] has been a common approach for testing body-ownership (see Botvinick and Cohen, 1998 for more details). RHI experiments have shown that, so long as the hand appears as a hand, changes to appearance do not prevent the sense of embodiment occurring nor do similarities increase the chance of it (Tsakiris, 2010), yet a perceived sense of embodiment did create a perceived sense of similarity between the rubber hand and the body (ibid) potentially indicating that even if the body schemata cannot be extended through incorporated tools, prosthetic replacements do not need to be 'like for like'. This provides some interesting possibilities, as historically aesthetic appearance has been a significant reason for rejection (Murray, 2010; Herr et al., 2003), particularly amongst BAME populations who may be not be offered limbs that match their skin tone. In chapter nine I use this as the basis for reframing the way we think about human-technology relationships to place aesthetic (and sentiment, which I put in a similar role to aesthetic) in a more significant position.

Drawing these points together, despite being prevalent in literature from a wide range of field, both transparency and body-ownership are problematic criteria for establishing whether a tool or prosthetic has been incorporated into the body. I have identified three primary reasons for this. The first is that, following ecological approaches, more-than-human communication occurs around us all the time, so these technologies frame our actions regardless of whether they are viewed as belong to the body. Furthermore, a technology which fits into a category that would normally be considered as incorporated, such as a climbing shoe, can draw attention to itself without failing in its purpose thus disputing the need for transparency. These two points indicate that transparency alone is insufficient to indicate incorporation. Secondly, body-ownership does not appear to expand and shrink in direct proportion to peri-personal space, despite the two often being conflated. This indicates that tools and prosthetics may act as feeling parts of the body without being felt *as* parts of the body. This appears to suggest that greater attention needs to be paid on more-than-human communication and the

[10] an experiment which uses a carefully placed mirror and rubber hand to make the participant feel as though the rubber hand is their own hand (which is hidden away at the time).

experience of tool-use rather than perceived ownership, which leads into the third point – the issue of object agency. While this has only briefly been touched on throughout this section, this is intentional. The question of object agency – raised in both previous literature review chapters – appears largely ignored in discussions of incorporation. Admittedly, the presentation of tools as non-neutral (e.g. Verbeek, 2005) goes some way resolving this, but still leaves much to be achieved, and so this is a point which I return to through my empirical work, most notably in chapter nine.

4.4 Conclusion

This chapter has provided an overview of the various literatures surrounding the limits to the body. In doing so it has drawn attention to the nature of the body as processual, dynamic and by no means contained by any physical form. The result is a body which changes not just over time, but also with the relationships it forms. It is a body which can extend into, with and through other bodies. One could conclude that it is, in fact, not *a* body, but *multiple* (Mol, 2002) or *multistable* (Ihde, 1993) bodies. Yet the body itself is not the centre of interest here and so such debates are not entirely within the scope of this thesis. What this thesis is interested in, however, is the kinds of relations bodies – human or otherwise – enter into, and the various arguments of leaky, overflowing, and otherwise extended bodies presented within this chapter all point to the need for such research. In establishing that the body is, at least in part, defined by and distributed across its relationships, this chapter has identified a continuing need look not at the "things themselves" but at their interactions (following Ihde, 1993), something this thesis aims to do.

This highlights the suitability for a postphenomenological approach, which not only permits a relation-centric – rather than a human-centric – position, but also enables this research to remain grounded in the experiences of such relations. It is also an area where geography provides a platform to reconsider the role of human/object boundaries through its attentiveness to more-than-human relations and object agency (e.g. Ash, 2017) as well as the *lived* experience of these relations, something notably lacking from most accounts (Murray, 2008). However, geographical study also has its limitation. The humanist history of geography means that our attention only started to turn to in- and non-humans around us towards the end of the twentieth century. Despite a longstanding interest in technology (Dixon and Whitehead, 2008) which can be traced back as far as 1894 when Otis Tufton Mason proposed the idea of 'technogeography' (P. Adams, 2007), geographical study of tools has tended to carry an unspoken prefix of 'the human use of,' which I believe is reinforced through incorporation-based approaches discussed above. Over a series of three reports (2013, 2014, 2015), animal

geographer Henry Buller called for an "ontological reconfiguration" (2013: 312) of how the field approached the position of animals in geography, a reconfiguration which would challenge the human inherent to 'human' geography. I believe that much the same is necessary for discussions of tool use. And while some work is already heading in that direction, such as materialist geographies (see Anderson and Toila-Kelly, 2004 and Anderson and Wylie, 2009 for more on this) and more recently in post-phenomenological geographies (Lea, 2009b; Lea 2020), there is still a long way to go.

This chapter, then, has served as a kind of 'state of the union' message. It has drawn together prevailing ideas within discussions of tool- and prosthetic-use and highlighted common themes between them while working to situate them in a broader discussion of body-boundaries. The theories discussed are not unproblematic, and some of these issues have been attended to, yet they provide a point of departure for the empirical work of this thesis. Some of the theories used here play significant roles in later chapters, albeit they are reworked in the process. In particular, scaffolding, as used by Downey, is used to consider the role of instructors in empirical chapter one, while ecological approaches to skilled tool-use situate practice in a broader context for empirical chapter two, and, finally, empirical chapter three returns to the wider issue of incorporation to ask whether bows are incorporated into the archer or whether there are more suitable ways to model the relationship. Aside from these points of focus, the broad range of theories serve to be "sensitising device[s]" (Hinchliffe, 1996: 660) to the whole thesis, constantly raising the joint questions of whether human and non/inhuman body boundaries exist in a meaningful way, and why that matters.

5. Cybernetics

If the postphenomenological influence on this thesis is found in its focus on relationships rather than things and its suite of analytical tools, then the contribution of cybernetics is to provide the vocabulary required to describe the flows, patterns and interactions which this identifies. I begin this chapter by outlining a brief history of the rise(s) and fall(s) of cybernetics before turning my attention to a selection of the key concepts which are at the heart of this work. The history of cybernetics is convoluted and formed of many twists and turns – including moments where it folds back on itself – from where it has been applied by a range of fields, meaning the account provided here is only one of many potential accounts. It is also, in one sense, a largely forgotten history (Rid, 2016). As I will work to show, many cybernetics concepts are still widely used (such as the cyborg, or reflexivity) or have influenced contemporary work in other ways (e.g. Zhang, 2020; Angus et al, 2001; Swyngedouw, 2006) including in geography, indirectly, through the works of cybernetics-inspired authors such as Deleuze and Haraway. I pick just five snapshots from this history to demonstrate the enduring relevance of cybernetics. I then continue to weave this demonstration through the three concepts that make up the latter half of this chapter before linking them back to geography in the final section.

5.1 The History of Cybernetics

To speak of *a* history of cybernetics is a slight misnomer. As Pickering identifies in his own narrative of the discipline (2010), the term 'cybernetics' attempts (with varying success) to bring together a diverse and disparate array of fields of study. As a result, it has no single history for us to trace. Information theory and systems theory were key to its evolution in the United States (See Hayles, 1999; Kay, 2001; Rid, 2016). Here key figures included John von Neumann (1948), Warren McCulloch (1965), Heinz von Foerster (1949; 1958) and Norbert Wiener (1948; 1950). By contrast, British cybernetics, the kind Pickering (2010) focuses on, was always closely tied to psychiatry and psychology (through the work of Ashby (1956) and Walter (1953)) and operations management (in the case of Stafford Beer (1968; 1972)). In this section I provide a short overview of five particularly important moments within the field. For the most part these snippets follow the trajectory set out by Wiener, starting with his work in the early 1940s, for his work (and that of his successors) bears the greatest resemblance to my own. For my first snippet, and as a brief introduction to cybernetics, I look at Wiener's 'protocybernetic' work (Pickering, 2010) before moving on to the Macy Conferences, during which cybernetics first

began to emerge as a field. I then address the advent of Artificial Intelligence research and the subsequent fall of cybernetics. Next was a period of 'revival' for cybernetics, largely through the works of anthropologists and biologists in 'second-order cybernetics'. Finally, I introduce the concept of the cyborg. The narrative of the cyborg is central to this thesis but spans beyond cybernetics and merits much greater attention than can be provided here, so is addressed more fully and in its many forms in the next chapter. Here, I provide a short discussion of its origins within cybernetics. This is, naturally, a cursory overview. However, it is usefully illustrative of the cybernetic influences on this study, for this historical basis underpins my own motivations for adopting some concepts from cybernetics. It also identifies a number of ways in which cybernetics has had – now forgotten – influences on contemporary geographic literature.

Like much work at the time, Wiener's first steps in the world of cybernetics were taken in the name of military research. In December 1940, the then Massachusetts Institute of Technology (MIT) professor Norbert Wiener was awarded a small grant by the recently formed National Defence Research Committee (NDRC) to conduct research into the possibility of a technological solution to predicting the flight paths of enemy fighters. It was hoped that this could improve the hit-miss ratio of anti-aircraft weapons (Masani, 1990). At the time, the Blitz was near its peak and anti-aircraft technology was naturally highly desired. Yet Wiener's funding allocation was the smallest awarded by the NDRC's fire control division – just $2,325 (Masani, 1990)[11] – and the project was ultimately terminated late in 1942. During this two-year period Wiener, with the assistance of engineering graduate Julian Bigelow, had (unsuccessfully) attempted to model the behavioural patterns of pilots avoiding ground fire using statistical analysis. Although their research had provided nothing the NDRC considered to be practicable before its premature end (Mindell, 2002), Wiener and Bigelow had reached several theoretical conclusions which would later lay the groundwork for cybernetics. The first of these was found in recognising that the behaviour of a pilot was constrained by the plane (and vice-versa). From this Wiener noted that the pilot-plane system could – indeed needed to be – considered as one entity (Rid, 2016). This marked a turning point for Wiener who became increasingly interested in the ways humans and machine resemble and interact with one another. The continuing military applications of protocybernetic research caused some unease amongst its soon-to-be founders, especially Wiener. This reached its peak with the use of nuclear weapons at Hiroshima and Nagasaki, which Wiener believed had "made clear that to provide scientific information is not a necessarily innocent act and may entail the gravest of consequences" (Wiener, 1947). Despite this,

[11] Between 1940 and 1945 the NDRC's fire control division funded more than sixty projects relating to land-based antiaircraft. The average value of funding was $145,000 - the largest contract was $1.5 million (Rid, 2016).

military research divisions remained home to many of the most successful and advanced cybernetic research projects for years to come. Rid (2016) attributes this to an abundance of funding and a clear focus – both lacked elsewhere. The field's association with warfare has stayed in the minds of many, Pickering states that "cybernetics is often thought of as a militarist science" (2010: 14), which may explain why few academics admit to its influence. Yet this origin, one of communication between a weapon and its user, finds itself readily applicable to non-military research in my own work. The ideas Wiener worked with even as early as 1942 – such as planes and pilots acting as a single entity – are just as relevant to archery as a contemporary sport as they were to anti-aircraft instalments in World War II.

Barely four years after the NRDC ceased his funding, Wiener was invited to attend the first of the Josiah Macy Jr. Foundation Conferences. While the history of cybernetics has multiple strands and countless origins, the ten Macy Conferences held between 1946 and 1953 are the point where many of these met. It is, arguably, the most defined moment in the shift from protocybernetics into cybernetics proper. The likes of Ashby, Walter, and McCulloch (who, Pickering groups with Wiener as "founders" of cybernetics (2010)) were present. As was Bigelow, representing an engineering background, and anthropologists Gregory Bateson and Margaret Mead. The diversity of the attendees may seem eclectic, but this was a key point the conferences sought to build on – improved communication between different scientific disciplines, an idea which had been discussed by many of the attendees in a precursor meeting held in 1942, while Wiener was with the NDRC. Yet it was not until the war ended that the full conferences became possible (Conway and Siegelman, 2005). Wiener had been a keen believer that the "most fruitful" scientific discoveries to come existed in the "no-man's-land" between established disciplines (1948:8). Yet the vision of a productive discussion was quickly shattered. McCulloch, who chaired all ten meetings, later recalled "the first five meetings were intolerable. Some participants left in tears, never to return." (2004: 356). The variety of different approaches, technical languages, and priorities led to conflicts (Hayles, 1999) – a fact Wiener had anticipated (1948). But, as those who remained pressed on, the conflict gave way to moments of productive friction and introduced scholars to entirely new ideas. For individuals such as Bateson, the Macy Conferences marked a turning point in their own work. Bateson's approach to anthropology was significantly altered by Ashby's psychiatry research, as is evident in his *Steps to an Ecology of Mind (1972),* as a direct result of their interactions at the meetings. From the very outset transdisciplinarity was a core feature of cybernetics, and nowhere is this clearer than at the Macy Conferences. Pickering has gone so far as to describe cybernetics as being "antidisciplinary" (2010: 9) suggesting it is instead a "way of going on in the world, even an attitude" (ibid). The transdisciplinary nature of cybernetics lends itself well to this study – it offers a technical language specifically designed to speak across

disciplinary boundaries. This is regarded as one of the major legacies of the Macy Conferences (Conway and Siegelman, 2005) and will enable to me to draw on ideas from a wide range of literatures. Some of these key terms and concepts that do this will make up the later sections of this chapter.

With the final Macy Conference taking place in 1953, cybernetics appeared to be firmly founded. Wiener's *Cybernetics* (1948) had received critical acclaim despite being largely technical, the conferences had pooled together a diverse selection of some of the greatest thinkers of the time, and public interest was high enough to merit a number of cybernetics text being written for lay audiences (such as Wiener, 1950; Shannon and Weaver, 1963). However, another paradigm shift began to occur in 1956. During 'The Dartmouth Summer Research project on Artificial Intelligence', held that year, the field of Artificial Intelligence emerged as an independent field. John McCarthy, the organiser of the two-month workshop, chose to break away from cybernetics and give the field its own identity to avoid being at odds with – or subordinate to – Wiener (Nilsson, 2010). Cybernetics and AI co-existed for about a decade before the latter "gained control of national funding conduits and ruthlessly defunded cybernetics research." (Cariani, 2010: 89). As a result, the many threads which had come together to form cybernetics began to unwind, beginning what might be described as the 'Dark Ages of cybernetics' within the computer sciences.

While cybernetics had combined psychiatry, psychology and computer engineering to attempt to generate intelligence in machines, the first phases of artificial intelligence (symbolic AI, or 'Good Old Fashioned AI' (GOFA) (Haugeland, 1985)) worked to simplify intelligence down to the manipulation of symbols – a task for which computers had proven to be adept. Hubert Dreyfus, who has written extensively on the process of skill development, has been a vocal critic of the transition since the earliest days (see Dreyfus, 1972; 1992; Dreyfus and Dreyfus, 1986). He argued that attempts to mimic human intelligence through symbol manipulation would prove fruitless with many of his criticisms of the predictions surrounding AI now being accepted as true (Crevier, 1993). Drawing on the work of Merleau-Ponty and Heidegger, Dreyfus leveraged a phenomenological critique which purported that symbolic AI could not account for instinct and lacked the 'being-in-the-world' essential to human cognition. Dreyfus further argued that there was a distinction between "knowing-how" and "knowing-that," with the former referring to intuitive and mundane 'everyday skills' while the latter described the kind of logic based practices which might be reduced to the inherently rule-based and representational process of symbol manipulation (1986). As such, artificial intelligence research was limited to only recreating a sense of "knowing-that" – an approached Dreyfus claimed was destined to fail and likened to "tree climbing with one's eyes on the moon" (1992: 119). Cybernetics, by contrast, entails an inherently performative approach (Pickering, 2010) that could attend to non-representational aspects of the world. Pickering points to Walter's 'turtles' – small, sensor-laden

robots designed to independently navigate space while avoiding obstacles – as an example. These constructions did not process their environment symbolically but reacted to it as a series of sensory inputs. As AI and cybernetics each strove to develop thinking systems, at the heart of their search were the questions of how humans learnt and how this could be replicated. The phenomenological and performative attitudes found within cybernetics research position it well to engage with discussions of skill that are taking place in geography. The resistance to symbolic AI, and Walter's approach to the turtles' navigation systems demonstrate an appreciation of tacit knowledge and non-representational ideals long before their rise to prominence in geography.

Just as AI was pushing cybernetics out of the computer sciences, the field began to blossom within the humanities and social sciences as "second-order cybernetics." This new reflexive take on cybernetics was led by Macy Conference attendees Gregory Bateson and Margret Mead, both anthropologists, and physicist/philosopher Heinz von Foerster. In its simplest sense, second-order cybernetics (also called "the cybernetics of cybernetics" (von Foerster, 1974) or "neocybernetics" (Hansen and Clarke, 2009)) refers to an approach to cybernetics in which the cyberneticists consider themselves to be intertwined with the system they study. This stance bares a strong resemblance to issues of reflexivity found in geography, particularly in feminist geography. In one interview von Foerster explained that the introduction of reflexivity was central to the shift between first and second-order to cybernetics. He believed that the attitude that "the properties of the observer shall not enter the description of his observations" was the source of "our cognitive blind spot… "objectivity."" (von Foerster, 2003: 285). For second-order cyberneticists, objectivity cannot simply be substituted for subjectivity, instead von Foerster proposes a question to ask when conducting or reviewing research: "What are the properties of an observer?" (ibid). The emphasis on recognising the role of the researcher speaks to the focus on positionality in contemporary geographical research (England, 1994; Rose, 1997; Fisher, 2015). Indeed, second-order cybernetics – particularly through its shift from the 'hard' sciences to social sciences – increasingly resembles contemporary social science. Hansen and Clarke (2009) identify that the theories and approaches of second-order cybernetics have been deployed by the likes of Deleuze and Guattari, Serres, Latour, Haraway, and Stengers, in texts that have become foundational in geographic study. The need for second-order cybernetics was first proposed by Mead in 1967, but it matured with the publication of Maturana and Varerla's *Autopoiesis and Cognition: The realization of the Living*) in 1980 (Hayles, 1999). Autopoiesis refers to systems which can maintain and reproduce themselves (for example, living organisms) and was a core focus of second-order cybernetics. While the first-order approach had been largely influenced by physics and engineering fields, second-order cybernetics was more frequently dominated by biologists and life and social scientists. Much of the influence of second-order cybernetics within this thesis is therefore implicit in

the design of the methodology. The issues of reflexivity and positionality that it raises are at the heart of my approach to the fieldwork. In particular, second-order cybernetics sensitised me to questions about how my presence and identity affected the field (and vice versa) and encouraged me to incorporate my own experiences further into the research.

The final stop in this brief tour of cybernetics is the cyborg. Ideas of the cyborg have run throughout the history of cybernetics in one form or another. While the creation of the concept of a '**cyb**ernetic **org**anism' was certainly not the climax of cybernetics, it is a point where many for whom cybernetics is alien will find themselves in familiar territory once more and thus a fitting conclusion. Within geography and the social sciences, the cyborg is most well-known through the work of Donna Haraway's *A Cyborg Manifesto* (2001). However, Haraway's cyborg was intended to be largely metaphorical – a complex intertwining between X and Y. The original conceptualization of the cyborg was both more, and less, like the machine/human hybrids we might recognise from popular media. In 1960 two scientists working at the Research Centre of Rockland State Hospital – Manfred Clynes and Nathan Kline – published a paper entitled *Cyborgs and Space.* In it they proposed that "an increased knowledge of homeostatic functioning" drawn from "cybernetics aspects" which were "just beginning to be understood" could enable an individual's body to be adapted to survive in hostile environments (1960: 26). This cyborg is familiar as a fusion of bodies and technology, but unusual in that Clynes and Kline envisaged many of these adaptions as being largely biochemical – potentially owing to their positions in a psychiatric centre. Although Clynes and Kline's paper was the first to coin the term and the most explicit in directly attending to the issue, cybernetics had long since been questioning the divide between humans and technologies. As I have already noted, Wiener and Bigelow's anti-aircraft research had required them to think of plane and pilot as a single entity (Rid, 2016). Taking an indirect route through the work of Haraway, the more-than-human geography elements of this thesis, as well as the many fields of literature discussed in the next chapter, are already direct descendants of cybernetics. And while the ideas of feedback, communication and noise are perhaps more readily associated with cybernetics, one could attribute that to the cyborg taking a life of its own. The study of the cyborg is as much of a hybrid as the creature itself. Cybernetics was described as inherently opposed to disciplinarity, but the cyborg can almost be said to bring this full circle. It has provoked the emergence of many sub-disciplines (see, for example, Amber Case's work in 'cyborg anthropology' or any number of fields and academic movements sparked by *A Cyborg Manifesto*). Despite being inherently transdisciplinary, the cyborg is also the genesis of disciplines, the start of an understanding that we live and operate in a more-than-human world.

The work of Wiener, the Macy Conferences, the rise of AI, second-order cybernetics and the cyborg all represent critical turning points in the development of cybernetics as a field. I chose to narrate

these particular events as each holds some connection to contemporary literature or the setting of this work, and because they speak to cybernetics' diminished presence in academia. This chapter so far, therefore, has sought to draw a connection between cybernetics in the past and my research in the present. Having briefly attended to just a few of the key moments the interwoven histories of cybernetics, I now move on to introduce a series of core concepts – communication, feedback and noise – which this thesis adopts and adapts from the cybernetic approach. Using these concepts as a language, this thesis can later explore how we can rethink our understanding of skill as a more-than-human flow of information.

5.2 Cybernetics Concepts I: Communication

With the complex history of cybernetics in mind, in this section I outline the first of my three concepts – communication. With each of the concepts I will work to highlight the ways that these ideas remain in use (sometimes with different names) or have directly influenced other contemporary concepts. In doing so I aim to establish links between cybernetics and geography to show that the cybernetic language and theory can be – indeed often is – a part of a geographical approach. I will also identify similarities between cybernetics and postphenomenology. I begin with the concept of communication, which cybernetics uses to discuss the interactivity of people and things across more-than-human systems. Through this concept I begin to identify a language I can later use to describe how archer and bow respond to each other.

At its heart, cybernetics is the study of communication across systems (Young, 1969; Wiener, 1948; Pickering, 2010). Many of the other concepts within the field – including noise and feedback – are just specific instantiations of communication. Importantly for this thesis, the cybernetic approach has always seen communication as occurring across more-than-human systems. It is a 'lively' communication, not reduced to language and representation, but instead it finds a focus on embodied performance and performativity. In this overview I begin by introducing entropy – a homogenising force that makes possible the concepts of information and communication. From this, I highlight how communication takes place within a context and that this context must also be part of the study. This includes the material aspects of communication ('the medium for the message'). Using the work of Katherine Hayles (1999) I link this notion of materially bound communication to contemporary geographical work on embodiment and object agency.

Like much of cybernetics, the notion of entropy is drawn from the 'hard sciences' –thermodynamics, in this instance – where it refers to the probable distribution of energy within a system. The most likely arrangement of energy (highest entropy) is randomness, and the least likely (lowest entropy) is defined organisation. Thus, entropy has been confounded with chaos and disorder by some, including Wiener (1948). The least structured and therefore most probable state is a universally equal distribution – or 'mix – as demonstrated in Figure 6 (below) because this is the greatest dispersion. Wiener characterises this uniformity as a loss of "distinctiveness" (1950: 12) but here I will describe it as *homogeneity*. Under the second law of thermodynamics the entropy of a closed system always increases (that is, it tends towards disorder). However, this describes the system overall. Local patches of decreasing entropy are balanced out by increases elsewhere. The only way for the total entropy of a system to decrease is if an external force acts on it to effect the change (i.e. the system becomes part of another, larger system – across which total entropy would still increase).

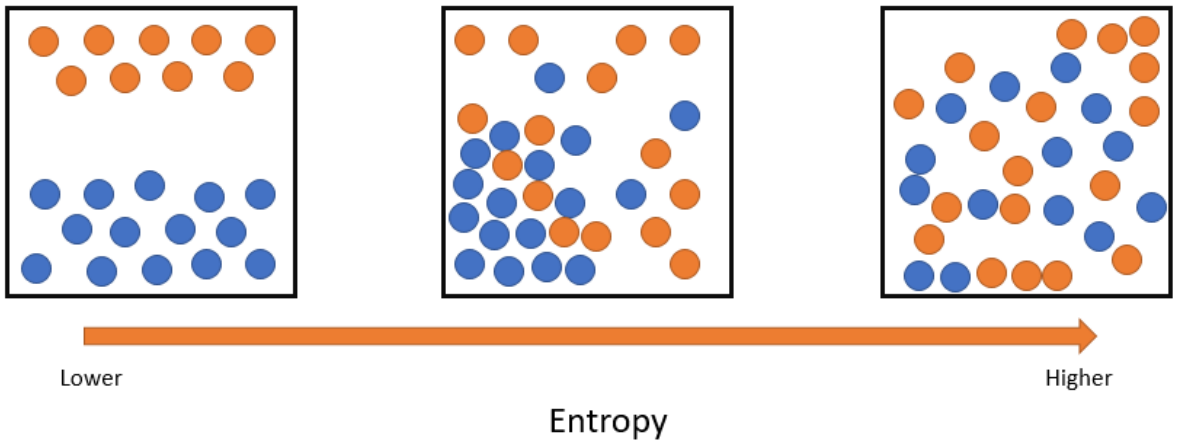


Figure 6 Entropy Diagram

One way to think of this is to imagine milk mixing into coffee. Even without stirring the cold milk (orange) will gradually mix into the hot coffee (blue) until the distribution is even.

Claude Shannon first proposed the need for an "information entropy" in a paper entitled *'A Mathematical Theory of Communication'* in 1948. After much debate, Shannon chose the term 'entropy' following a discussion with von Neumann who recommended it on the basis that "no one really knows what entropy really is, so in a debate you will always have the advantage" (Tribus and McIrvine, 1971, quoted in Bavaud, 2009: 54). Rather than being the average distribution of energy, information entropy is about the average amount of information output from a system. This requires an understanding that the message transmitted during communication is not the only message that could have been communicated. Or, as Ashby explains "the act of "communication" implies the existence of a *set* of possibilities" (1956: 123, emphasis in original). Literary theorist Katherine Hayles provides a more general example of this in her own exploration of cybernetics (1999). Hayles poses a

scenario in which nine of the possible assignments she might give her class are on book A and one is on book B. When she communicates which assignment is being given, she will be implicitly communicating which assignments *will not be given.* However, Hayles uses this example of further demonstrate the importance of probability in communication. Bateson defined information as "a difference which makes a difference" (1972: 381), information provides meaning and structure and is therefore inherently negentropic (induces negative entropy). Less probable outcomes make a greater difference and therefore convey more information because they imply the negative occurrence of a greater number of (or likelihood of) possibilities. In Hayles' example, should she communicate that the assignment will be on book B then she will be conveying more information than if she told them it would be on book A because she is eliminating nine alternatives rather than just the one. The main point that this illustrates is that communication does not happen in isolation. There is a probability element to it, as any message must be considered as part of a set of potential messages. This then requires an understanding of the presence of absence and absence of presence because what is present is partially defined by what it could have been but isn't (an idea discussed in the postphenomenological notion of background relations in the previous chapter).

Once we begin to appreciate that communication and information are contextually framed, the question becomes one of the limits of the context. Beyond the need to consider the broader set of possibilities, attention has also been paid to the material framing of a message. The two are not always easily distinguished – the physicality of the medium of a message may constrain, expand, or otherwise determine the set of possible outcomes. I turn again to Hayles, who has approached the issue of the materiality of information in the contexts of both a literary standpoint and from a posthumanist view. Both are pertinent here. Hayles has claimed that "the physical form of the literary artifact [sic] always affects what the words (and other semiotic components) mean" (2002: 25). In other words, any shift in the material substrate of a message equates to a shift in the *meaning* of the message itself. Hayles adopts the term 'material metaphor' (ibid: 22) to describe this. Material metaphor alludes to the "traffic" between the words and the physical artefact through which they are presented. Further work on this can be seen in Hayler's research on technological mediation and the e-book (2015). Both Hayles and Hayler present this contextuality in such a way that it appears as a sort of non-human embodiment. This can be seen more clearly in another of Hayles' works, *How we Became Posthuman* (1999). The book opens by discussing a Hans Moravec novel wherein Moravec argues that humans will one day be able to upload their minds to machines (Hayles, 1999: 1). Hayles identifies similarities between Moravec's proposition and a similar claim made by Wiener in which he proposed that the only thing limiting us from transmitting humans via telegraph was a set of temporary "technical difficulties" (1950: 103-4). While some have argued that, in an abstract sense, we are distributed

across the world 'via telegraph' (See Zylinska, 2002; also discussions of distributed cognition in the next chapter) Wiener and Moravec overlooked the issue of embodiment that Hayles draws attention to. That is, just as the information of a message is intertwined with the medium in which it is written, the information of human experience is woven into our corporeal identity. Hayles by no means suggests there are concrete barriers which define the limits of the body, but she is critical of any notion that we could "do away with the body" in its entirety (1999: 12). The failure of Wiener, and other cyberneticians, to appreciate the importance of embodiment points towards a key value of the field: it is not burdened by the humanistic history that geography and other social sciences share. Their oversight stems from cybernetics' fundamental lack of meaningful distinction between human and nonhuman, living and non-living. Where geography works to overcome the human/non-human dichotomies embedded in its past, cybernetics has never had them.

Hayles' work therefore provides an important bridge between cybernetics and contemporary studies of the body and corporeal experience. Early cybernetics, with its basis being largely in maths and engineering, tended to favour generalizable theories which risked decontextualizing the object of study all the while trying to emphasise the importance of context. The early work of Shannon – the same Shannon who created the idea of information entropy – was notable for this. Shannon's work created mathematical formulae to model information flows (see for example Shannon and Weaver[12], 1963) which limited the ability for specific contexts to be considered. This was a failing of first order-cybernetics, one which was partially remedied by the second-order approach of taking a further step back to acknowledge positionality. But Hayles is, from the perspective of this thesis, the most prominent figure in properly placing information back in its (not-necessarily-human) body. Hayles' critique pushes us towards a greater understanding of embodiment in a cybernetics approach (Hayles, 1999). In doing so, a platform is created for further work on communication across more-than-human systems which recognises the vitality of the nonhuman while resisting anthropomorphisation. It is for this reason that cybernetics can supplement, but not replace, a geographical approach to this study.

Within the field of geography this can be applied in a number of ways, one example would be within the context of 'visceral methodologies' (Sexton et al., 2017). Visceral methodologies attend to "important questions around what it means, how experiences differ, and how it *feels* to be a particular body – researcher or researched – amongst other (non)human bodies." (ibid: 200). Writing as part of a special issue on visceral methodologies, Ash speaks of an ongoing-yet-often-forgotten communicative interaction between people and things through which "bodily styles can allow the non-human to express itself" (2017: 206). Ash uses the example of the electric guitar requiring a

[12] Weaver of the NDRC, for whom Wiener briefly worked.

certain bodily comportment from the musician to illustrate this, but the implications for archery are evident and will be explored in more detail in later chapters. What Ash demonstrates is that communication can occur across more-than-human interactions and the shapes, styles, and materiality of the "(non)human bodies" (Sexton et al., 2017: 200) are part of this engagement. The special issue further demonstrates this through Sweet's (2017) exploration of body-mapping as a means of sharing personal stories of abuse. Here, the medium of the message – the body map – not only changes the message itself but also the ways it is presented, the ability to present it and the entire atmosphere of the experience as Hayles anticipated (2002). Geographers have also shown an appreciation of this through explorations of performance. Eden and Barratt (2010) compare the experiences of fishing and climbing, respectively drawn from their own research, in outdoor and indoor environments. They observe that the transitions between spaces – themselves a medium through which messages are conveyed – altered the ways in which people engaged in the performance, and the kinds of people the practice attracted.

What this section has endeavoured to show is twofold. The first is that, through Hayles' reworking of it, cybernetics provides a language through which to discuss embodied experience and communication across systems which is specifically tailored for a more-than-human world. The second is that there is a desperate need, and a continuing effort to establish, such a language within contemporary geographical study. Although I have not addressed it directly, the notion that the content of a message is partially shaped by the medium through which it is conveyed is reminiscent of the notion of technology as 'unfaithful messengers' which interject their own messages (Michael, 2000; see also Ihde, 1993) as discussed in the previous chapter. This thesis, therefore, adopts the language and concepts of cybernetics as tools for later analysis. This section has provided a general overview of communication, in the following two sections I look at specific instantiations of communicative practices in the forms of feedback and noise.

5.3 Cybernetic Concepts II: Feedback

The first of these instantiations of communication to consider is 'feedback'. Feedback describes a process of self-correction and adjustment based on past performance (Wiener, 1948; 1954). Wiener also notes that it can be implemented in any situation from specific movements to entire "policies of behaviour" (1954: 32) leading to it being described as the most influential concept drawn from cybernetics literature (Vallée, 2003). In this section I briefly introduce feedback loops and divide them into two categories: positive and negative. Rather than focusing on the history of feedback – which

would largely overlap that of communication – I then explore three ways in which feedback can be applied and identify how these are of use to the thesis. I begin by looking at trans-human experience and feedback loops as a challenge to body boundaries. I then use the work of Pickering to argue that feedback loops are performative and can be used as part of a non- (or more-than-) representational approach. Finally, I look at homeostasis and self-correcting system with reference to the cyborg.

A non-scientific definition of a feedback loop might be *a process by which each output becomes the input for the subsequent output*. Such loops are all around us. They play a key role in learning in humans and animals, the process of evolution and the functioning of technology. As such they can be both biological and synthetic – as well as combinations of the two. Just as with communication, the term 'feedback loop' describes a category of processes. Of interest here are just the two highest subcategories – positive and negative feedback loops. Rosenbleuth et al. (1943) further subdivide these for greater specificity, but many of their subdivisions are largely arbitrary in the context of this study. Positive feedback loops are divergent and produce indefinite expansion in either direction (Salen and Zimmerman, 2003). Systems with a positive feedback loop tend towards a (positive or negative) infinite or zero value. In geography a commonly used example of a positive feedback system is that of a runaway snowball Earth scenario. Once ice coverage reaches a certain level the albedo effect is sufficient to reflect enough of the sun's radiation to cool the planet, allowing more ice to form and exacerbating the effect. This continues infinitely until an external factor disrupts the loop. Negative feedback loops, by contrast, tend towards a set, stable value. They are convergent. Central heating and cooling systems are an example. When the temperature is too low the system seeks to increase it to the set value, but when it overshoots that value the system switches to decreasing it. The oscillation between increases and decreases continues to maintain stability on and around the convergent value. Such systems can be described as homeostatic – an idea I will return to later.

The implications for feedback loops are significant. Feedback loops can operate within but also across systems, joining them as part of a third, greater system. Because of this they can provide everyday examples of more-than-human communication. Feedback signals can extend across physical limits of the body – whether human or non-human – and instead draw limits and border based on the flow of information. Bateson describes this using the example of a scientist's microscope and blind man's cane – incidentally echoing the example Merleu-Ponty used in his phenomenology (1962):

> "It is not communicationally meaningful to ask whether the blind man's stick or the scientist's microscope are 'parts' of the men [sic] who use them. Both stick and microscope are important pathways of communication and, as such, are parts of the network in which we are

> interested; but no boundary line-e. g., halfway up the stick-can be relevant in a description of the topology of this net." (Bateson, 1972: 251)

Lister et al. (2003) observe a similar phenomenon in their study of cybernetics and videogames:

> "We do not see here two complete and sealed-off entities: the player on the one hand and the game on the other. Rather there is an interchange of information and energy, forming a new circuit … Through the tactile and visual interface with the machine, the entire body is determined to move by being part of the circuit of the game, being, as it were, *in the loop* (pg. 370. Emphasis in original).

Further studies on videogames and skill noted that games can utilize feedback to determine how players interact with it, for example punishing players for not working together to facilitate a cooperative approach (Giddings and Kennedy, 2008). These examples emphasise the importance of exploring the overall system, rather than individual aspects. An approach which is echoed in Ingold's "taskscapes" (2000) and Clark's work on distributed cognition (1999) which are discussed in in the previous chapter. Along with providing a tool for analysis, the system-based focus that this highlights is also seen in the scope of the methodology. By looking at the relations (using postphenomenology) and the constituent system (with cybernetics) the study can avoid creating overly human-centric view.

Beyond its more-than-human focus, feedback is a key component of this project due to its inherently performative nature. Pickering (2010) identifies this as part of the cybernetic ontology, an ontology in which one does not need to fully understand an object or phenomenon to react to it. As such, cybernetics becomes about "performance as *performance*, not as a pale shadow of representation" (pg. 21, emphasis in original). Once again, he provides the example of Walter's turtle, which reacted to light without ever 'understanding' it. For Pickering this aptly summarises the role of cybernetics: to study systems to "address the problematic of getting along performatively with systems that can always surprise us" (ibid: 23). He calls this an "ontology of unknowability" (ibid) in reference to the fact that the systems which are of interest to cybernetics are too complex and too fast changing to be pinned down by engineering and scientific approaches. Pickering's claims echo those of Thrift's non-representational theory, and this is no coincidence. Both authors were influenced by cybernetics directly through the work of Bateson (see Thrift, 2000; 2008; Pickering, 2010) and more so indirectly as cybernetic ideas dispersed through other fields during the latter half of the twentieth century. Just like the ontology of cybernetics, non-representational theory is not a discrete field, but rather an interdisciplinary approach focused on performance, events, and organism-environment interaction (Thrift, 2008; Thrift and Dewsbury, 2000). Through the focus on performance and performativity, feedback loops – and cybernetics more generally – can be integrated into a geographical approach

alongside non-representational theory. Feedback loops help us understand performance as being interactive and – as a form of communication – bound up in issues of materiality.

Finally, feedback brings the concept of homeostasis to this thesis. Homeostasis refers to a system's tendency towards a point of equilibrium, achieved and sustained normally through the utilization of negative feedback loops. Homeostasis is essential to life and to the functioning of many technological devices, however it can also have an affective dimension and applications to archery. As mentioned before, archery has been described as "the art of repetition" (Needham, 2006). It is a mastery of the act of doing the same thing over and over again – a "repetitive, independent closed skill" (Gordon, 1992, in Bawden and Maynard, 2010). As such, homeostasis – although never described as such – is a desirable property for any archer-system as it provides consistent base from which actions can emerge. An archer may need to take actions to reach the homeostatic point of equilibrium whenever changes are brought about in the system. For example, if an archer buys a more powerful bow then more power will be put into the arrow. This would then need to be balanced out by making changes to the arrow to compensate for the increased stress it would be placed under. These examples of negative feedback are more-than-human as they only occur through the interaction between the human and non-human elements of the system. Moreover, *they are specific to the kinds of interactions between those specific elements and the ways those interactions unfold.* No part of the bow or person could be replaced without destabilising the homeostatic processes. These processes, therefore, demonstrate that the feedback loops are far more than just a 'socialising' of different components, the interweaving extends beyond the surface. The feedback is ingrained in the performance of each part of the system and the identity of the total system, it is configured as a co-dependency. In other words, through feedback the components are co-created.

It was through a desire to extend the body's homeostatic systems that the cyborg was imagined (Clynes and Kline, 1960). As the cyborg tells us, homeostatic systems can be expanded through the implementation of additional negative feedback loops (albeit the point of equilibrium may not remain the same). We can use this to think not only of ways that humans and non-humans cooperate as part of a system, but also to recognise these loops as informative communication that transcends the limits of the body as was discussed in the previous section. Homeostatic systems require the functioning of all feedback loops to maintain stability, and so a particularly pertinent for calling into question the limits of the body. For in a system where the continued operation of one component requires the continued operations of another, we cannot truly consider these two things to be distinct. But this point also introduces a vulnerability to homeostatic systems: the formation of feedback loops which cross boundaries, if sufficient to create interdependence, leaves any single component of the system vulnerable to the weaknesses of any and all other parts of the system. In other words, homeostatic

more-than-human systems are fundamentally vulnerable to anti-homeostatic processes. These disturbances and patterns of interference – called 'noise' in cybernetic terminology – are themselves a form of communication. Noise can disrupt non-homeostatic systems (e.g. positive feedback loops or non-feedback-based communication) and play a significant role in all communicative processes. As such, I turn to consider the process of noise now.

5.4 Cybernetic Concepts III: Noise

So far, the emphasis of this chapter has been on looking at how meaningful signals are constructed and communicated. Here I turn my attention to how attempts at communication might be disrupted by undesired signals – 'noise' – creating interference. In cybernetics the term noise is used to describe and measure "the amount of disturbance" in a system (Wiener, 1948: 42). Such disturbances can be sufficient to cease all functioning or breakdown a system in its entirety. As a result, Wiener at times depicted noise as a quasi-spiritual evil. He described it as "the arch enemy" of scientists, a "demon" or "devil" (1950: 34) a stance which was directly contradicted by later (predominantly second-order) cybernetic thought. This characterisation of noise as a chaotic disorder against which meaningful signal must battle (Hayles, 1999) can be readily compared to Heidegger's notion of unreadiness-to-hand (1954). Noise was seen as something which a system (such as that comprised of a workman and his tools) must overcome to achieve fluidity and unity. Noise breaks systems down by affecting the ability of components to communicate, causing them to act as individual entities rather than part of system. This understanding is therefore readily applicable to the performance of archery – noise can be understood as impeding a process of incorporation or cooperation that would be expected from skilled action. How this unfolds in practice will be the focus of a later chapter.

It is important to recognise that noise is distinguished from the more conventional 'signal' predominantly through its undesirability[13]. Noise is, therefore, communicative and subjective. What constitutes noise is highly contextual and is determined by the needs of the system across which communication is occurring. Because noise is inherently communicative, something Wiener possibly did not appreciate, it was later seen as being vital for any communication. One major proponent of this stance was French philosopher Michel Serres. Serres has written extensively on noise. In archaic French, the word 'noise' carries connotations of dispute and altercation, a fact Serres makes full use

[13] 'Noise' is therefore a specific type of signal. The term 'signal' is used here to describe only those messages desired (i.e. in contrast to noise) for the purpose of simplicity.

of as he presents a chaotic depiction of noise akin to that of Wiener. Indeed, Serres draws on Wiener to provide a metaphor for the role of noise in communication (Hayles, 1999):

> "[C]ommunication is a sort of game played by two interlocutors considered as united against the phenomena of interference and confusion, or against individuals with some stake in interrupting communication. These interlocutors are in no way opposed… they battle together against noise. *To hold a dialogue is to suppose a third man and to seek to exclude him.* [S]uccessful communication is the exclusion of the third man…We might call this third man the demon, the prosopopoeia of noise." (Serres, 1982: 66-67 emphasis in original; See also Wiener, 1950)

Despite this, Serres' noisy chaos is one from which new order can emerge (1980; Serres and Schehr, 1983). Again, Serres' claim is firmly rooted in cybernetics, this time the work of Gregory Bateson and Henri Atlan. For Bateson the randomness of noise was the only possible source of new information (1967) whereas Atlan proposed that, while noise was an obstruction for the sender of information, it need not be so for the recipient (1974; Brown, 2002). Applying Atlan's work in a reading of Serres' philosophy, Brown suggests "slips of the tongue" and "unintended deviation[s] from a script" as examples of where information can be gained from noise (2002: 7). Serres' also describes how noise may be interjected by the medium through which a signal passes (Brown, 2002), a stance similar to that seen in the postphenomenological work of Ihde.

This association between noise and novel information can also be seen in recent neurological and biomedical studies (e.g. Quartarone et al., 2006; see also Bissell, 2012). This gives way to my first example of how cybernetic theories are still ingrained in contemporary academic practice. Of particular relevance to this thesis is their use in studies of tool manipulation including sporting practices. In sports the terms 'yips' and 'choking' (Bissell, 2012) are used to describe a phenomenon that could readily be understood as noise. Both terms refer to a problematic affective compulsion that occurs during performance under pressure; it can take varying forms but is always characterised by a decreased ability to act and often a sense of detachment (Bissell, 2012). The precise mechanics behind the yips are not fully understood. It has variously been attributed to "excess neural plasticity" stemming from ineffective "homeostatic control" in the brain (Quartarone et al., 2006: 127), something akin to writer's cramp (Sachdev, 1992), and a "breakdown of the brain-body-environment circuit" (Bissell, 2012: 124). All three suggestions are describe instantiations of noise – they refer to undesired signals (physical, affective, environmental, or otherwise) overwhelming and/or interfering with communication between components in a system. Moreover, all three studies additionally point to an increased likelihood of the yips occurring during moments of increased pressure such as

competitions. Thus, there is a process of feedback involved. The sensation triggering this does not have to be a negative one, as Sutton describes: "the vainglory after one sweet cover drive, a temporary manic narcissism which perseveres, skewing my allowable response repertoire as the next ball arrives" (2007: 764).

By taking this perspective the yips, and skilled performance more generally, must be understood contextually. The environment (spatial, temporal, atmospheric) is not merely a background for performance to occur but an active part of the performance (Bissel, 2012; Ingold, 2000; Payne, 2018). Such an emphasis on contextuality is also found in a cybernetic approach (Pickering, 2010). Moreover, we can start to understand skill as being inherently communicative in nature, a theme which is woven throughout the empirical elements of this thesis. Finally, we can see how noise can work in practice, and so can begin to describe the experiences of an undesired signal drowning out all others, an idea I discuss in detail in chapter eight. But the yips are not the only instantiation of noise that has been studied in a sporting context, experiences of pain have also drawn considerable attention.

One of the key themes of pain within academic literature is its ability to defy communication. In Elaine Scarry's *The Body in Pain* (1985) pain is characterised as actively resisting definition. She draws on the literature of Virginia Woolf to exemplify the difficulties one experiences while trying to describe pain:

> "English, which can express the thought of Hamlet and the tragedy of Lear has no words for the shiver or the headache ... The merest schoolgirl when she falls in love has Shakespeare or Keats to speak her mind for her, but let a sufferer try to describe a pain in his head to a doctor and language at once runs dry. "(Virginia Woolf 1967, cited in Scarry 1985: 4)

Although she does not draw on cybernetics directly, Scarry's account of pain being opposed to communication suggests some connection. This theme continues in the wider literature; pain is seen as inhibiting our awareness and enjoyment of, as well as our engagement with, the surrounding environment (Green, 2011; Wylie, 2005) and can be an isolating experience (see Bissell, 2009; Melzack and Wall, 1996). It is depicted as an often, but not always (Green, 2011), unwanted signal which overwhelms through its very intensity (Bissell, 2009). But as Serres claimed, pain – as noise – is itself communicative. Green's (2011) study of pain in martial arts demonstrates this. Green describes a process of "forced reduction" whereby experiences of pain cause the body's attention to be drawn in on itself. During such moments awareness of the pain overrides all other sensations but, for Green, this is not necessarily negative. Green's participants describe pain as being a grounding experience that "cuts through preoccupation leading to … the discovery of 'self'" (pg. 391; see also Spencer, 2013). This highlights two things. The first is that even when cast in a positive light, pain is still seen as blocking communication. *Even when it is communicating, pain does so at the cost of communicative signals.*

The second is that there are lessons which can be learnt from pain, whether they are moments of self-discovery or just increased awareness of the location and type of injury, experiences of pain do tell us something.

Although experiences of pain are absent from early cybernetic literature – just as cybernetic theories are absent from contemporary research on pain, despite the evident overlap – I propose that we can consider pain to be a human-centric instantiation of noise. In doing so this prompts new questions about how pain might be used productively, how it might call into question the limits of the body and how the distinction between noise and signal is contextual. It also provides an important tool for starting to model more-than-human experiences of pain and how experience takes place across body boundaries. Both of these will be built upon in throughout the thesis. In this section I have introduced noise as a concept drawn from cybernetics but, as I have identified, one which is ingrained in literature in many fields. I have demonstrated that the concept is not new to studies of sport, but by explicating the cybernetic influences pre-existing models of noise (such as the yips and pain) can become more nuanced. Furthermore, I have established the importance of contextuality and raised questions about the taking shape of more-than-human experiences – particularly how seemingly human sensations can affect the non-human elements of a system. These can then be attended to later through empirical data.

5.5 Geography and Cybernetics

Geography's history with cybernetics is one characterised by ghostly presences. In terms of explicit interaction – that is, geographers openly acknowledging cybernetic roots to their work – there is almost none. Yet cybernetic ideas themselves, perhaps most notably that of the cyborg, permeate geography. In part, this can be attributed to the indirect influences of cybernetics which have reached geography through theorists such as Donna Haraway, Michel Serres, Gilles Deleuze, and Felix Guittari. Through these authors, cybernetics has influenced the ways geographers think about bodies and more-than-human relations. Aspects of performativity in non-representational theory (for example, Busser, 2013) and the drive to explore (or question) the limits of the body (for example, Abrahamsson and Simpson, 2011) bear the hallmark of a cybernetic approach, one which has been assembled in conversation with a diverse array of other influences.[14] Within my thesis, cybernetics is used because it provides a language specifically designed to focus on relations – as both kinds of post(-

[14] It would be impossible to provide a definitive list of such influences but prominent examples include feminist theory (for example, with Haraway's work), literature studies (following Hayles' work) and social and cultural anthropology (through a breadth of influences ranging from Bateson to Ingold).

)phenomenology call for us to do – without privileging human actors. Terms like 'noise', 'communication', 'feedback', and 'entropy' are not uniquely applicable to human experience meaning they are well suited to describing *more-than-human experience.* Within this thesis, cybernetics serves to contribute to approaches to more-than-human geography and the concept of atmospheres by providing a language which decentres human experience.

Lorimer et al. (2019) have recently criticised geographers use of the concept of atmospheres for being anthropocentric and called for research into how nonhuman others (specifically, animals in their work) experience their effects. Atmospheres are social creations, which "emerge in relation to the complex social (or at least interpersonal) dynamics" of groups (ibid, pg. 30). Perhaps this could explain the foregrounding of animate humans and nonhumans, but in recent years geographers have sought to recognise the social lives of nonplant and nonhuman others (DeSilvey, 2007; Reno, 2009). As such, the continued focus on the experiences of 'living bodies' seems an oversight. Cybernetics enables me to explore atmospheres as they are experienced by more-than-human entities. As cybernetic approaches do not see it as meaningful to distinguish between human and nonhuman bodies when experiences are transmitted across their limits (for example Bateson, 1972: 252; Lister et al, 2003: 370), my use of cybernetic language does not centre experience in human bodies. Instead, atmospheres are a specific and important mechanism through which forms of communication (such as noise) are conveyed regardless of whether it is experienced by human actors or not. The ability to dis-locate the experience of affective atmospheres from human bodies is one of the key contributions developed throughout this thesis. In Chapter Eight I develop this to explore how disruption occurs across the relationship between archer and equipment and how atmospheres play a role in configuring this.

While I have noted that there is little to no explicit use of cybernetics in geography, recent work by Vickie Zhang (2020) has adopted the cybernetic concept of noise to discuss issues of exposure and vulnerability. Although Zhang draws the term from the work of Michel Serres' work, Serres himself was influenced by cybernetics as has been discussed throughout this chapter. Zhang's work uses the idea of attuning to noise as a kind of reparative act – something I echo in my empirical chapters using a broader set of literatures. Zhang argues that this mindset lets us take something – whether that is data, life experience, or a better understanding of the subject and participants – from noisy encounters. This is a Batesonian interpretation of noise, one that sees it as a kind of chaos from which new ideas and experiences can emerge. Although it is beyond the scope of this thesis, the combination of Zhang's work on attunement and my own suggests a potentially promising area of research on resilience and vulnerability in data collection and fieldwork. By drawing on cybernetic concepts – like noise, communication, feedback, and attunement – geographers can engage in methodological reflections about what it means to be a vulnerable researcher and to work within

this vulnerability, building on ideas of relational ethics (Ellis, 2007; also discussed in more detail in Chapter Six).

Cybernetics is difficult to define – a trait which ultimately led to the field falling into obscurity. As discussed earlier in this chapter, Pickering felt that it was more a description of mindset or attitude calling it an "antidisciplinary" field (2010: 9). But similar criticisms have been levied against geography, which itself has been described as a "rag-bag – a messy mix of bits and pieces" (Bell, 2009: 437). Geography's "magpie" approach (ibid) combined with its attentiveness to more-than-human relations means that geographers are well positioned to take up the torch cyberneticists have left in the humanities. As geographers seek ways to attend atmospheres without solely focusing on the *human experience of* atmospheres (see Lorimer et al., 2019), the potential for cybernetic concepts to facilitate this requires exploring and my attempts to do so forms one of this thesis' contributions to the literature.

6. Methodology

6.1 Introduction

This chapter outlines the methodology of my thesis. It is an institutional requirement that any thesis submitted as part of a graduate degree contains a description of the research methodology, whether it is an independent chapter or integrated elsewhere (University of Exeter, 2018). Beyond the requirement to include such a section, there is little guidance on what it should contain. Similarly, despite the plethora of research about designing research methodologies, the literature on how to *write* a methodology chapter is much sparser. It appears the contents of a methodology chapter are taken for granted. The few papers which do directly attend to this aspect of research are generally oriented towards positivist laboratory science approaches. In one such paper, medical scientist Richard Kallet, considers the methodology to be "the most important aspect" of research as it is through this section that "the validity of a study is ultimately judged" (2004: 1229). He further explicates that it is necessary that "the writing of the methods be clear and orderly to avoid confusion and ambiguity," going so far as to state that "compound sentence structures should be avoided" (ibid). In early iterations of this chapter I interpreted it as an opportunity to relay the logistics of the fieldwork – the number of interviews, the wording of consent forms, generic descriptions of the history and validity of the methods I chose. And so, despite adopting an autoethnographic approach, despite spending a year immersed within a field site, the chapter essentially glossed over the *me-ness* of my research. There was scant mention of the new friends I made and the old ones I lost, nor the literal investment of blood, sweat and time required.

Even in autoethnographic work we can obscure our identity and draw the reader's attention to the fieldwork itself throughout the empirical chapters. It is in the methodology that we, the researcher, are potentially most exposed. That exposure carries consequences – as a result many academics are reluctant to foreground their mistakes in methodology sections for fear of undermining their work – and so the temptation can be to shift the focus elsewhere. But. unlike the classic positivist science of researchers like Kallet. the intention of this methodology is not to tell others how they can replicate this study to verify my results, but to show *precisely why they cannot.* Researchers are so heavily embedded in their research that they cannot be separated from their work to provide an objective overview (England, 1994), a fact that geographers recognised and responded to. Furthermore, the use of reflexive analysis to reveal the reality of researcher experience is "ultimately a political act" (Finlay, 2002: 544) which can empower both researcher and participant by challenging the expectation to

produce ‘sanitized’ (ibid) accounts of doing research. As such, although this chapter does describe, explore, defend, and critique the methods I have used, in this version of the chapter the emphasis is no longer solely on the research project itself. Instead the chapter serves to provide an opportunity to highlight how my own narrative is inherently woven into this work at times taking a quasi-biographical – or even quasi-confessional – nature. To recreate the story of this research in the most faithful representation possible I have structured it along a (partially artificial) chronology, beginning with the initial project design and ending with the data analysis.

6.2 Project Design

The earliest concept of this project stemmed from my undergraduate dissertation which explored the role of pain in martial arts. I had spent a year participating in a Japanese martial art called *kenjutsu* which involved various weapons, but predominantly focused on the use of a sword. One of the questions which arose out of the project was how pain altered a fighter’s perception of the sword as part of the body. This, alongside my long-standing involvement with the university’s archery club, formed the basis of my application for an ESRC-funded scholarship.

Preliminary reading helped me refine my aims and objectives to those discussed into the introduction, which I return to here. The aim of the thesis, and one of the few aspects of the project which remained consistent throughout the process, was to develop an understanding of how more-than-human systems take shape and are transformed – and from where this transformation comes about. A further emphasis was added to exploring the importance of skill to these transformations, and to provide space for the nonhuman elements to come to life. To achieve this, I created the four objectives outlined earlier:

1. To understand the processes by which the body is transformed to work alongside a prosthetic element in an assemblage or system with different (spatial) capacities.
2. To explore the intimate and potentially productive geographies of (cybernetic) noise.
3. To understand the movement from hesitant bodies to intentional actors, with particular reference to how agency and affect(ivity) operate within more-than-human systems.
4. To situate the specific spaces and practices of archery within the broader literature of geographies of embodiment, performance, and practice.

With these objectives in mind I sought to create the sense of "alignment" between a project's aims and objectives and its methodology, which Starks and Trinidad view as being essential for generating results which are both "useful and well received" (2007: 1372). The focus on skill meant that this was a project concerned with progressive development – transitions and transformations over time. My first consideration was therefore establishing a methodology which maintained a presence in the field for an extended period. I was conscious that a drawn-out study may invite participant drop-out – student sports clubs like EUAC already have high drop-out rates as workloads change throughout the year. I believed that it would be possible to overcome some of the risk here by limiting my expectations of the participants. By opting for an ethnographic methodology, one which was about me becoming a 'co-participant' (Thomas and Pollion, 2002; Gruppetta, 2004) as much as the participants becoming co-researchers I hoped to reduce a sense of hierarchy between researcher and participant whilst also minimising the impact of my research. This logic acted as a disincentive for the use of participant diaries and similar participant-led methods, which I felt would have been asking participants to commit too much. To further emphasise the position of co-participant I opted to study a practice I was already engaged with - archery. This provided further benefits – locality, cost, ease of access. However, the practice of undertaking research in a familiar environment also posed an unexpectedly complex ethical dilemma. This quickly became the next hurdle for me to overcome.

6.3 Ethics

Ellis (2007) poses the question "if our participants become our friends, what are our ethical responsibilities towards them?" (pg. 4-5). To this I add a further question: what if some of our participants were *already* friends? To answer this question, we can seek guidance from those approaches that posit friendship as a method (Tillmann-Healy, 2001; 2003). Although I would not categorise my approach as such, the ethical nuances needed to the negotiate the power imbalances that I encountered – in both directions – as a result of working with friends finds a firm footing here. For Tillmann-Healy, friendship as a method requires "that ethics remains at the forefront of our research and researcher relationships" (pg. 745). The kind of ethics being deployed here are distinct from the 'procedural ethics' and 'situational ethics'[15] identified by Guillemin and Gillam (2004) but would be more readily categorised as 'relational ethics' (Ellis, 2007). This ethical approach "requires researchers to act from our hearts and minds, to acknowledge our interpersonal bonds to others, and

[15] Briefly, procedural ethics refers to institutional ethical review processes whereas situational ethics further considers the realities of the field, notably the fact that does not always pan out as anticipated.

initiate and maintain conversation" (Ellis, 2007: 4). Discussions of power relations, access, consent, confidentiality, and other facets to ethics all become ongoing conversations (Tillmann-Healy, 2003) as institutional ethics frameworks are often insufficient due to a systemic bias towards research on strangers (Ellis, 2007; Denzin, 2003).

One prominent ethical question posed by my pre-existent relationship with gatekeepers and participants was to what extent they felt able to opt-out of my research or deny me access. Tillmann-Healy (2003), drawing in part on Weiss (1998), characterises friendship as being distinct from family and marriage due to the "absence of obligatory dimensions." Yet, I would suggest the opposite may be true. We *do* feel as though we have obligations to our friends – whether we do in actuality is a different matter – and, unique to friendship, the repeated failure to meet these obligations alone is sufficient to diminish the relationship. Going into the field I needed to negotiate a fine line between gaining consent and obliging cooperation. As Tillmann-Healy suggests, the only real solution to this was to maintain open, overt conversation about the power dynamic. I was careful to tread careful and not interfere with the running of the club. Both practices we, as researchers, would normally aim for anyway, but knowing that any resistance to my position might be directed at friends who saw themselves as doing me a favour added more emphasis to its importance. When it came to interviewing there was much less concern. My friends were keen to get involved and did not appear to consider participation as anything more than us 'hanging out'. Many of the conversation topics of the interview were commonplace for us anyway, and, as MacAllister (2016) observed in her own interviews, at times it was only the presence of the recording equipment that stopped us forgetting it was anything else. Indeed, when other obligations were limiting my availability to interview there were instances where participants who I considered to be friends were repeatedly asking when I would have time to interview them. In many senses the onus was reversed – I was pressured to make sure I included their voice.

In seeking access to the club, I felt that an opt-in system was infeasible for the ethnography as the population of the club was large and fluctuating. Instead, I opted to approach the club's committee as a gatekeeping organisation and seek their consent *on behalf of the club.* The rest of the club was then made aware of the study and my presence and provided the opportunity to opt out. This not only streamlined the logistic process but acted as a form of continuing consent (see Dyer and Demeritt, 2009) and established a power dynamic which left the elected committee visibly in control. Although no one chose to withdraw from the study, had they wished to, they would have had two options. The first would be to withdraw entirely. In this case no further observations would be made of them and any data directly relating to them would be destroyed. The second was to withdraw going forwards. Had this option been chosen they would have been giving me consent to keep any data I had already

collected about them but be forbidding me from making any further observations. As an additional part of my agreement with the committee, I was permitted to source interviewees from the club. My requests for interviewees were broadcast over the club's social media relatively unsuccessfully, with most interviewees agreeing to participate following face-to-face conversation. Interviewees were provided an additional consent form to sign, along with my contact details should they wish to withdraw.

Approaching the committee as gatekeepers had its limitations. Bryman (2008) characterises the processes of approaching and negotiating with gatekeepers as a political process. This certainly appeared to be the case. My 'formal' negotiations occurred solely through the club's captain who, besides chairing the committee, was a supporter of my research and personal friend. This helped smooth the conversation and keep the expectations realistic, however, as I will attend to later, it raised some ethical questions. Some members of the committee suggested that some of my funding could be diverted to the club. I countered this by suggesting that my position in the club was – to my knowledge – unique and that having a researcher embedded in the club may provide them with an advantage in applying for external funding, adding that I would be open to supporting funding applications for projects where our interests overlapped such as coaching workshops. However, no such projects came to fruition as the club's attention fell elsewhere. Ultimately, we reached an understanding where I would be provided access with the proviso that my work was minimally invasive and would not negatively impact the club. In return I was not expected to provide anything specific, but it was recognised that my presence in the club was valuable due to my previous experience with archery as well as my position as a researcher. The lack of any specific "research bargain" (Bryman, 2008: 142) eventually became a hindrance. As I discuss later, restrictions were placed on my access when I was removed from the competition squad. The lack of a 'quid pro quo' left me with little to negotiate with, and no incentive for the gatekeepers to "go to bat" when obstacles arose (Berg, 2009: 206). Instead, I had to leverage my personal relationship with the club's captain. Not only did this have limits, but it could also have raised further ethical concerns had I tried to hold the club to the original agreement.

I believe that carrying out my fieldwork in the earlier stages of the project was beneficial as it meant that by the conclusion of my research most participants would have graduated making it harder to identify them. I further hid their identities through a process of pseudonymisation. Participants were assigned a pseudonym, those who requested a specific name were normally granted it (unless two participants requested the same name, or the name was deemed to be offensive or otherwise inappropriate). All participant data, including backups, was further secured on password-protected devices. Signed consent forms were similarly kept secure. While conducting analysis I would

occasionally need to print copies of interview transcripts. This was always done post-pseudonymisation and the copies were kept on my person and then destroyed when they were no longer needed. No one else had access to my raw data, and my decision to type field notes up when I got home meant that there was never any real volume of confidential information in my possession whilst in the field, just the occasional jotting.

Controversial topics, particularly interpersonal disputes between members, did arise during my study and were, for example, recorded in interview. However, these were rarely directly relevant to the study and almost entirely unused. As such the pseudonyms were largely a piece of general research etiquette and to reduce the risk of someone being unhappy with how they portrayed. Yet, the close-knit nature of the core of the club leaves me doubtful that any effort to anonymise participants would have proved effective were someone determined to unwind them. Some characteristics and events are far too memorable and unique to obscure, but also too academically important to exclude (Ellis, 2007; Vidich and Bensman, 1958).

6.4 "Entering the Field"

To claim that I 'entered' the field is not simply misleading, it is a lie. An honest 'mistruth' at best, or else a perilous deceit. I think, perhaps, it would be libellous. To understand why, however, it is first necessary to understand what is meant by 'entering the field' and how my experience differed. My rejection of the phrase is not novel, although my intention in doing so is less common. The designation of a 'field' (and the implicit 'non-field'[16]) has been a source of discussion within academia. The term finds routes in the idealised notion that research in constructed of three clearly defined stages: preparation, fieldwork, analysis, and writing. Social science research, however, rarely takes place in such a stringent format, and I would be inclined to say that, if anything, it was an indication of bad research design, not good, if it did. In part, this is because, as Till reminds us, the concepts of field/non-field are "unstable categories" (2001: 46) in need of reconceptualising (Rogers and Swadener, 1999). Concerningly, these categories have the troubling potential to affect our perspective of our participants. If in leaving the field we shift our focus on to data analysis and the production of anticipated scholarly output (Blommaert and Jie, 2010; Henderson and Woods, 2016) then with this comes the overwhelming drive (perhaps even requirement) to see our participants as data points.

[16] I avoid using 'institution' or 'home' as alternatives to 'field' in recognition of the fact that these categories are not mutually exclusive.

People no longer, these data may be moulded, contrasted, discarded. When the possibility of abandoning of the stories of participants is considered, it becomes a question of "hard-won knowledge" ending up on the "cutting room floor" (Becker, 2007: 31; see also Schiellerup, 2008). Perhaps, then, it is not surprising that another vein of literature attending to this discussion highlights the issues of 'returning' to the field in light of what is (and isn't) disclosed by our research (Ellis, 2007; 1995).

Yet it is not the presence of a 'field' that leads me to turn against the phrase, but the notion of 'entering'. Wolff (2004) similarly critiques 'entering' as inaccurately implying a clear divide with an unrestricted view. Instead he favours 'access' as being a term which is more open to the realities of the ongoing and processual nature of negotiating our position in the field. Access is something that can be withdrawn, something that must be maintained. And so, through the term, we can speak of our efforts to maintain a relationship with the field and its gatekeepers, but also the precarity of our situation. Not only *can* access be withdrawn, but it often is also, explicitly (Thorpe, 2014) and entirely (Cook, 2001) or through more subtle and informal 'distancing' (see Edwards, 2005). There were times when my 'access' was limited, impeded, or otherwise reduced, and these will be discussed elsewhere in this chapter, here I am focusing on the first moment of my fieldwork.

My fieldwork began in September 2017. The first session I attended at EUAC as an observer was the first session that I had attended in roughly three months. It was also, however, the first session to take place in this period. My absence had not been an active 'leaving', but a passive 'being left'. The field had been suspended; it had withdrawn from me. It is for this reason that I reject the phrase to 'enter' or, even to 're-enter', the field.[17] To claim that I had done so would be as to stand at the shore and claim I 're-entered' the ocean each time the waves swept over my feet. Prior to my fieldwork I had been a member for five years. To this date I remain a member and, were it not for these periods of abeyance during the academic summer holidays, not a beat would have passed to mark these transitions. It would be true to say that I entered the field in a different state, with a different purpose, as a researcher. Yet people are not static, and this would be true of any two sessions – there have been far greater and more meaningful changes to my identity over the course of the last eight years than my role as a researcher. Moreover, the periods of before/during/after leak into one another as my feelings towards the fieldwork mar each – anticipation before, relief after. Similarly, the club itself had changed, in composition and management, as it did each year. There was nothing notable here. And so, I suggest that to claim that *I* entered the field would be to strip the field of its own agency. In

[17] Although, for ease of understanding, it may appear elsewhere

many senses I was at the mercy of the fields' natural ebbs and flows – for months I was ready to begin my fieldwork but needed to wait for the sessions to resume.

Reflecting on this process is important. Not only does it highlight the power relations – importantly including the position of power the field itself held – and the logistical challenges I faced, it demonstrates the centrality of this field site to the construction of my identity and the issues this raised during the fieldwork. I turn to those issues later in this chapter in section 6.7, however I first outline the experience of conducting the fieldwork itself, first with ethnography and then my interviews.

6.5 Ethnography

My primary method of enquiry was a reflexive form of ethnography whereby my experiences were not the sole avenue of enquiry but were disproportionately a focus to enable me to reflect on corporeal and felt experience. I wanted to encounter the relationships between people and technology in the moments they were experienced and for this to happen I felt that I needed to be present as those moments unfolded. My field site was Exeter University Archery Club (EUAC) where I carried out observations for a nine-month period – one academic year, but also a full competition season for the club. During this time, I sought to be fully immersed in the goings-on of the club. As other ethnographers, such as Green (2011), have noted, this means going beyond the practice itself. Like Green, I often found myself watching competitions, joining in on trips to the pub, and attending formal dinners. These moments formed a grey area between fieldwork and leisure. They did not factor into my near-three-hundred-hours in the field as recorded in my field diary, but nor did I consider them to be entirely optional. In these moments, the meaning of the sport and of the club were negotiated just as much as they were during sessions.

Research in which the researcher fully immerses themselves within the field, sometimes known as a Complete Member Researcher (Anderson, 2006), introduces the researcher to a complex – and at times costly – identity politics. While inherently linked to the ethnographic aspects of my methodology, this aspect was so substantial that I have chosen to address it in full later in this chapter. Nonetheless, it is important to note here that I made an effort to introduce myself at the start of the year, and an email was sent to all members containing the details of my project. I worked to maintain a balance between 'fitting in' and keeping my role as a researcher clear. My research itself was often a topic of conversation early on and so I was rarely concerned that people might feel betrayed to learn

that the comments they made were written down and analysed, yet at sessions where I tried to carry a notebook to write my observations down I felt far more isolated. I eventually reached a comfortable middle-ground between taking notes at the session and trying to write everything up afters by making small 'jottings' (Emerson et al., 1995) on my phone throughout the session. These could then be expanded afterwards without much being lost, and the occasional moment of typing on my phone drew no unwanted attention. As people became more acclimatised to my research I slipped out of focus and became a mere presence at the club. Only those with whom I had the closest relationship, many of whom had been friends before the study, continued to overtly discuss the project as the year reached its end. There were benefits to this, primarily that it provided me with more freedom to navigate the divide between researcher and participant, and switch between the two roles, as I saw fit. However, when my identity as a researcher was less prominent, my position within the club, and the access it provided, was called into question.

Anderson (2006) has reflected on how the difficulty of balancing the dual identity of researcher and participant requires a "frenzied multiple focus" (Alder and Adler, 1987: 70) in which notetaking and participation can be at odds with one another. In January 2018, four months into my project, I was removed from the competitive squad in a reshuffle because my research was deemed to be detracting from my shooting time and my questioning impacting the performance of others. Despite having discussed the practicalities of my project with the club's captain and received permission to conduct my research, decisions regarding the selection of squad members were made independently by the club's two squad officers. The people holding these roles had been appointed towards the end of December and therefore were not part of the original discussion or agreement. The club's captain interceded to ensure that I was still able to attend these sessions, but not participate. This provided me with continued access and actually worked to lessen the pressures of my dual identity. From this point onwards I shot considerably less and had more of an emphasis on observation and teaching. This moment highlighted the risks associated with sourcing participation through a gatekeeper. My position as a researcher and the access I had been provided with both became tenuous and the management structure shifted around me. These changes could not have been anticipated at the outset of the project, but my previous experience as a member of the club provided me with the awareness and understanding of the inner workings of the club to navigate the shifting climate.

Despite the obstacles I encountered when managing my dual identity, it was an essential facet of my research style. My approach was inspired by Gruppetta's claim that, if the contemporary methodological zeitgeist is that we should consider our participants as "co-researchers not subjects" (Thomas and Pollio, 2002:4) then it is only a short step further to include ourselves as co-participants (Gruppetta, 2004). The decision to describe my methodology as ethnographic is not unproblematic.

As Walcott (2001) reminds us, there is more to an ethnography than the field techniques adopted. Rather, in using the term 'ethnography' or an 'ethnographic approach', one refers to an attentiveness to patterns in behaviour, and the subsequent interpretation of these patterns. Such a definition does little to restrict the practice of ethnography, so it is perhaps unsurprising that a considerable number of subsets have arisen as ethnographers have carved out their own niches. These subsets facilitate the construction of more rigid methodologies, ones with a narrow focus and so, it could be argued, a stronger identity. To call my work autoethnography (such as in the vein of Allen-Collinson, 2012) would have specified the focus of my observations. To further identify it as either analytic or evocative (Ellingson and Ellis, 2008) would have clarified my intent and approach. Other terms were available to provide identity to my methodology: autophenomenology (Drummond, 2007), autophenomenography (Gruppetta, 2004), non-representational ethnography (Vannini, 2015), to name but a few. None of these terms would have been incorrect, strictly speaking. Yet, at the same time, none were quite correct either. While undertaking the reading for my methodology I found these terms to be too prescriptive. Entering the field site, I had little idea of what form my research would take. I did not want to identify myself with an 'auto-' prefix as I felt that doing so would be to place myself as the primary method *and* subject of data collection.

I recognised that I had a rare advantage. While I could not predict the direction my fieldwork would take, I did know the field itself. This allowed me to take risks others might not have been able to. And so, I entered the field trusting this my familiarity with the site would allow me the freedom to tweak my methodological identity and focus as I went. My method, therefore, would be described as ethnography – notably free of any additional prefixes or descriptors. From its roots in anthropology, ethnography has become closely associated with the notion of storytelling (Bruner, 1997). Literary theorist Roland Barthes once claimed that "of all learned discourse, the ethnological seems to come closest to Fiction [sic]" (Barthes, 1988). This thesis has an interest in the stories of the lives of people and things. There are many characters, followed over many lifetimes, yet it is the process of weaving together these individual – yet inseparable – narratives that was of interest to me far more than the characters themselves. Thus, it is a complex story, yet, undeniably, a story it is. Unavoidably, and so also deliberately, I was one of those woven into this confluence of lives. In recognising that this was inescapable I embraced my positionality as I entered the field as both a participant and researcher. The decision to adopt a method which was minimally prescriptive, one which would simply let things unfold and allow me to observe this unfolding, was a part of this positionality.

In addition to the narrative elements, another reason for choosing an ethnographic approach is that, as Laurier observes, it resembles the development of a skill (Laurier, 2010). In each we learn through observation and practice, having entered an unfamiliar world, full of vibrant lives and complex

orderings. For this reason, an ethnographic approach has provided richer experiential accounts and formed the firmest foundations from which to conduct my semi-structured interviews, as will be discussed in the next section. Choosing a method which resembles skill development helped to ensure that my experience of archery – despite being an experienced archer – had similarities with that of the novice archers. I learnt about researching archery as they learnt about performing it, with a shared interest in their development. These similarities were as informative as the differences in our experiences in so far as they helped highlight areas for me to delve into further and aided in structuring rapport and communication during the ethnography and interviews. This was particularly evident in the way that it deconstructed knowledge hierarchies. I did not enter the field as an expert, despite being an experienced archer competing at a national level. Instead, I entered with as much to learn about archery as I had to teach. I was not viewed by the novices as an expert instructor, but as someone with whom they could co-produce knowledge by each of us sharing our own understandings, experiences, and approaches. This was, therefore, a mutually beneficial arrangement in which knowledge was exchanged for knowledge, and experiences were exchanged for experiences. My position as an experienced archer meant that I could focus my time and energy into this part of my identity, without having to worry about keeping pace with the training regimes of the novices.

Another benefit to an ethnographic approach was that, as a participant, I could interject my own experiences throughout. This means that the extracts from my field journal which are used in the later empirical chapters incorporate aspects of my own encounters, as well as those of other people. Being fully immersed in my field site provided me with the opportunity to reflect on my own relations with equipment, thereby enabling me to shift the emphasis away from merely describing the relations I witnessed onto describing *the feel of the relations* I both witnessed and experienced. Capturing the affective moments of field experience was achieved by noting my own position within it. My decision to do this has precedence within previous literature. Lofland states that "field notes are not only for recording the setting; they are for 'recording' the observer as well" (1971: 106), an approach which has reflected in previous anthropological work, where personal field notes were often published alongside their research (termed 'auto-anthropology' by Strathern, 1987). As Reed-Danahay (1997) notes, this is not a fully autobiographical method, but one which nonetheless interjects "personal experience into ethnographic writing" (pg. 2). Thus, my work remains insufficiently 'auto-' to require the prefix, but nonetheless maintains a level of reflexivity which proved a useful tool for latter analysis, particularly in identifying patterns for coding.

As a final point, my ethnographic fieldwork closely linked to my interviewing. Not only did my ethnography provide an opportunity to source interviewees, but I was also able to identify topics in

my ethnography which I could then explore further in interviews. I explore this opportunity further in the next section, in which I outline how interviews were used as the secondary method.

6.6 Interviews

My second approach to data collection was a series of semi-structured interviews. As (Creswell, 1999: 455) remarks, multimethod research is not simply a matter of taking two separate approaches, but rather an attempt to interweave the two approaches to see "this world through multiple lenses." My interviews sought to supplement the ethnography by proving depth of analysis to the ethnography's breadth. While my ethnography exposed me to a wide range of experiences, the interviews enabled me to delve into these further and explore them from the perspective of those experiencing them. Interviews provided more direct access to the affective dimensions of performance on the range. Like my ethnography, my interviews were conducted with members of the EUAC and included a range of different levels of experience and competitiveness, bow styles, demographics, and roles in the club. Overall, I conducted ten single-session interviews, mostly within the period of my ethnography but several occurring afterwards. Interviews varied in length, with most being around forty-five minutes and the longest being an hour.

I initially set out intending to use the interviews primarily as a method of directing my ethnography. As I interviewed participants, I expected them to draw aspects of their experience to my attention which I would then observe in more detail when I returned to the field. Similarly, if events unfolded which I wanted to revisit, or for which I wished to seek clarification, then the interviews would provide an opportunity to do so. However, in actuality, the interviews provided a rich vein of data in their own right. To relegate them to being mere orientational tools would have undermined participants freedom and ability to speak of their own practices (after Hitchings, 2012) by implying that I was seeking 'confirmation' that the 'realities' they had described were indeed 'true' through my own observations as theirs were insufficient. This was clearly not my intention. However, as Macpherson (2010) indicates, we must remain mindful of the limitations of interviews to access certain kinds of (pre-discursive) moments.

I chose to use a semi-structured format to provide an opportunity to offer "participant the chance to explore issues they feel are important" (Longhurst, 2010: 103). While I encouraged participants to raise any issues they wished, prompts were provided based on data from other interview, my ethnography, and the literature. These prompts enabled a kind of 'talking around' key points in which

the interview could be kept 'on topic' but not feel constrained to answer in a particular way. Allowing participants to approach the interview in their own way was intended to reflect the fact that each participant would encounter the performance of archery in their own way and, as Valentine notes, the aim of the interview is "to understand how individual people experience and make sense of their own lives" (2005: 111). This, I believe, was to be best achieved through the semi-structured approach. I tended to use more directed questions in the earlier stage of the interviews to get conversation started and establish specific facts (such as whether they were trained by the EUAC) and then let conversation grow organically.

I transcribed most of my interviews immediately so that I had a clear memory of what had been said if there were any inaudible sections, but also because the process of transcribing raised concerns with the process itself. I had no experience conducting research interviews before this project and listen back to them as I transcribed allowed me to reflect on how I was approaching them. Notably, I felt as though I was leading the conversation too much in the earliest interviews. My phrasing of questions was insufficient to draw out longer explanations and so, although I did not dominate the conversation, my role was greater than it should have been. By becoming aware of this early on I was able to shift my approach and change my wording to encourage participants to expand upon their answers.

A key point of consideration for my interviews was the location. Over the past twenty years, geographers studying the relationship between people and spaces have sought to conduct interviews immersed within those spaces (or, in some cases, specifically removed from a particular space (Anderson, 2004)). These 'go-alongs' (Carpiano, 2009; Clark and Emmel, 2010; Ingold and Vergunst, 2008) enable the spaces to become interview prompts, guiding the discussion throughout the journey (Jones et al., 2008). While I would have liked to conduct interviews on the archery range, a number of factors – particularly background noise in the recording and health and safety concerns – made this approach undesirable. Following conversations with my gatekeepers, I made the decision to avoid this approach and instead seek to access these moments through the ethnography. Herzog (2005) directs our attention to the location of an interview as part of the overall 'interview structure', a structure which cannot be considered to be wholly distinct from the interview itself[18]. While, as Herzog further indicates, it is often considered good practice to allow participants to select the interview location. To simplify the logistics, I chose to hold all my interviews on the university campus but was flexible as to where. The campus provided a wide range of cafés and seminar rooms which were suitable for my purposes, as well as the sports centre where sessions took place. Interviews were predominantly

[18] Particularly not if one considers the interview to be an instance of cybernetic communication wherein the message and the means of conveying it cannot be easily distinguished.

spread across these three locations. The campus was also convenient for all participants as interviews could be arranged around session times or lectures. Finally, the campus was a neutral location – not due to any lack of meaning, as would normally be the case with public spaces, but precisely because it was a space so closely entangled with the lives of both interview and interviewee.

Although I was limited in terms of the location of the interview in terms of the physical space in which it took place, this itself can be critiqued as an all too narrow understanding of the interview process. Elwood and Martin (2000) define the interview site as "the location where the interview – an exchange of information between the researcher and research participant – takes place." (pg. 650). But this definition becomes complicated, and the lines between interview and ethnography become blurred, when participants contact the researcher post-interview to provide additional information that they were originally unable to convey. In such instances the interview 'site' is not so much a spatial and temporally bound point, but a series of transactions taking place across a relationship formed between participant and researcher. With this perspective in mind, the emphasis became one of ensuring that the rapport established in the interview continued and that participants felt that they could contact me to add further comments. This was another moment where the interview and ethnography overlapped, and when participants did want to add to their interview, they exclusively approached me during sessions and so I recorded this as ethnographic data.

The decision to use public locations, rather than the range, further limited by flexibility in conducting the interviews by preventing me from providing equipment for participants to use as a prompt. Barratt (2012) provides an example of the effectiveness of this approach, observing that physical objects may help interviewees explain themselves. This, I believed, would follow the direction of non-representational accounts (such as Thrift, 2008; Lorimer, 2005) which argue that aspects of corporeal and more-than-corporeal performances cannot be effectively communicated by words alone. While I previously argued against taking this stance unproblematically, by combining the interview with performance I believe I could achieve something that was more-than (Lorimer, 2005), rather than non-, representational. Through the use of objects, I had hoped that interviewees would be able to communicate through the kinds of demonstration and gesture that are used in teaching archery[19] as well as utilise objects as memory prompts. However, the pragmatic and logistic issues with interviewing on the range, or putting together a full set of equipment anywhere else, were constraining here. As such, I had to compromise and work without the equipment. Although none was present, many interviewees made gestures accordingly and attempted demonstrations nonetheless. As I had opted to not use video recording equipment for reasons similar to those above, this meant

[19] As is discussed in the empirical material, particularly chapter seven.

that these bodily enactions were unrecorded and untranscribed. However, they enabled the interviewee to clarify their intentions and direct conversation, as well as act as memory prompts. Given this, I believe it would be untrue to claim that the physicality of the interview went unrecorded, but rather I would claim it was sufficiently embedded into the interview process so as to be indistinguishable in the transcript. Nonetheless, after carrying out several interviews I began to realise that I could collect this data more effectively through informal conversations on the range. While I continued to interview – eventually completing ten interviews – they became a much lower priority when I was spending ten hours in the field. Given the significant periods of 'down-time' between rounds of shooting, I was still able to engage in conversation around experiences I wanted to probe further.

A final point of reflection regarding my interviews is my own role as an archer. I have previously considered how this impacted my study more generally, but the one-to-one nature of the interview setting exacerbate its effect. When interviewing novice archers, I was conscious of a notable hierarchy in terms of knowledge of the sport, and they frequently deferred to me to clarify techniques and technical terms. While I was cautious doing so for fear of leading the interview, at times it was necessary to do so to ensure conversation continued flowing. This bridged the issues of managing relationships as part of an interview and the learning curve I encountered to start with. Reason (1994) observes that, traditionally, the roles of researcher and research subject are mutually exclusive positions. Yet, I believe that the ethnographic aspect of my research worked to overcome this. By being seen in a familiar setting, undertaking similar experiences, a level of friendship was established that helped counteract any hierarchy. In particular, the fact that I was not a member of the committee, nor one of the most accomplished archers in the club, meant that I was on a more equal footing. While it was not possible to completely deconstruct the power imbalance, as Valentine (2005) suggests, sharing a similar background can be used to facilitate the development of a rapport. However, leveraging identity in research can place the researcher in a complex position. I return to these issues of researcher identity shortly, but first I further highlight the relationship between my choice of methods and the theoretical framework of this thesis.

6.7 Postphenomenological Methods

Such as it is ill-defined as a theory, the question of how post(-)phenomenology may shape methods, or what it means to do research *post(-)phenomenologically*, is perhaps more obscure. In the most simple understanding of the word, there is not defined 'post-phenomenological method.' Although

the approach's identity has become more cohesive of late (Lea, 2020), the breadth of interpretations has produced an equally broad array of means for doing post(-)phenomenology. This is arguably exacerbated, rather than alleviated, by the occasional emergence of Ihde's work into geographical fields (see for example, Kullman, 2016; Ash and Simpson, 2016). Within philosophy of technology's postphenomenology, discussions of methodologies have been sparse (Aagaard et al., 2018). Instead, postphenomenology has been understood as a particular way of thinking about human-technology relations, one which revolves around notions of mediation and co-constitution (Rosenberger and Verbeek, 2015). As such, applications of postphenomenology may well be best suited to follow in the footsteps of non-representational theory and act as a "background hum" (Lorimer, 2008) which sensitises researchers to certain dispositions and modes of inquiry. Geographers' discussions of post-phenomenological methods have been more overt (see Ash et al, 2018; Ash and Simpson, 2018) as they have sought to provide some direction for those seeking to undertake post-phenomenological research, yet even this has been minimal. Like those following Ihde, geographers have sought to focus on exploring the relations and mediation and people's use of technology. However, as I will discuss throughout this section, this approach to post-phenomenological methodologies is as open to the same critiques as that of philosophy of technology, namely 'theoretical' and 'empirical' contributions are poorly distinguished (Aagaard et al., 2018). In this section, I ground my chosen methods in postphenomenological theory to justify their appropriateness and consider what future postphenomenological inquiries might look like. I do this through two themes that both forms of post(-)phenomenology emphasise: materiality and lived experience.

Materiality

I turn first to the post(-)phenomenologies' shared drive to access the material dimensions of practice. In philosophy of technology, this can be traced back to the field's empirical turn which influenced Ihde to call for research to consider concrete examples of technologies rather than thinking about 'Technology' as it were an abstract concept (2009). This became a foundational tenant of postphenomenology (see Chapter Three for a full discussion of this), which has frequently been fulfilled through the use of case studies (Rosenberger and Verbeek, 2015). Using specific instances of technology enables postphenomenologists to keep claims grounded (Shaw et al., 2000) and avoid the same kinds of transcendentalism and foundationalism they associate with pre-empirical turn philosophy of technology and phenomenology. My work reflects this in its scope: a singular set of technologies (the archer's equipment) in specific application (hobbyist archery) carried out by a specific demographic (university educated, predominantly white, middle class, and heterosexual as well as mostly – albeit far from exclusively – able-bodied). As such, my work makes no claims about

other ranged weapons or sports equipment, nor other applications of archery (such as hunting), nor even how archery is experienced and performed by bodies beyond those involved in the study. This is not to say that the claims of this thesis are *not* applicable to other contexts, but that their applicability cannot be presumed and that this may indicate a need for further research that emerges from the intersections between geography and disability studies, queer theory and feminist literature.

Beyond this, postphenomenologists do not prescribe any method but have been seen to prefer (auto)ethnographic work with a component of literary analysis that usually focuses on 'science communication' literature (Aagaard et al., 2018). Postphenomenology distinguishes itself from Actor Network Theory in its interest in *relations* rather than *actors* (Verbeek and Rosenberger, 2015) and so it is perhaps natural that methods which immerse the researcher in these relations are favoured. Herein lies a potential shortcoming of the approach, some argue that this means postphenomenologists can only study the familiar (Aagaard et al., 2018). Given my prior relationship with EUAC this would not have prevented its use, but the critique itself seems limited. Technologies with which we are especially familiar can draw our attention less than those that are alien – this is the very basis of postphenomenology's 'embodied relation.' Familiarity can hinder our appreciation of materiality, and indeed it was my experience that it often did. During my fieldwork, it was necessary to consciously reflect on processes, experiences, and technologies that – as an experienced archer – felt mundane to me. Conversations with non-archery friends and my supervisors facilitated this, but ultimately it was through my observation of, and, more importantly, interviews with novice archers, for whom these were all new, that best guided my attention.

Geographers have provided a clearer, albeit still limited, discourse around postphenomenological methods (see Ash et al, 2018; Ash and Simpson, 2018). One form this has taken is that of *postphenomenological styles* (Ash and Simpson, 2018). Drawing on the work of Ma (2005) and Spinosa et al. (1999), Ash and Simpson propose the notion of style as a means of means of attending to the expressions of objects. These styles – of which they propose two examples: allure and resonance – are used as analytic concepts to interrogate the ways objects invoke and invite actions, and how they sit in the world. If we are to understand post-phenomenological styles as a means for centring the co-constituted nature of human-technology relations in research and as a tool for the "analysis of intentional experience" (Hepach, 2021: 10), then what novelty they offer is unclear when considered alongside long-established approaches in philosophy of technology such as variational analysis and hermeneutic strategies. Although no doubt a means of getting at the materiality of human-technology relations, styles fall afoul of the same critique levelled against postphenomenology in that their contributions are more theoretical than empirical (after Aagaard et al., 2018). Styles provide a way of *thinking* about our interactions with technology but offer little guidance for *doing* human-technology

relations. As such postphenomenological styles, along with variational analysis and hermeneutic strategies, may be more accurately thought of as postphenomenological *strategies* rather than postphenomenological *methods,* for they direct the attention of research and researcher but are compatible with a range of means of data collection. This is not to diminish the work that has been done in post(-)phenomenology to address methods and data collection, but rather to recognise how these concepts and styles of research act as sensitising devices which attune researchers to certain aspects of experience and facilitate centring data collection methods on specific (and often nonhuman) subjects.

With established literature offering little guidance – or, in a more positive light, relative freedom – for the uninitiated postphenomenological researcher, I chose to use ethnographic methods to facilitate my access to the material aspects of the archers' experiences and practice. While observing training sessions, the equipment and the range itself were as much participants of my study as the archers were. This enabled me to foreground them as having an active role in the performance of archery rather than attending to them through the experiences of other (human) actors. Geographers using Ihde's postphenomenology have similarly recognised the risks of objects being reduced to mere "props" in researchers' stories of human actors (Kullman, 2016). During the design of my research, I had sought to include archers' equipment in the interview stages as well (following Barratt, 2012). However, my agreement with EUAC precluded me from conducting any research they considered to be 'disruptive' during sessions, a term which they believed would include interviewing on-site. As discussed in previous sections, my interviews were therefore moved to public spaces where equipment could not be present in the same capacity due to health and safety rules. The desire to have archers and equipment present when interviewing was not simply so that the equipment could act as a 'prop', as Kullman (2016) admonishes but so that the archer-bow relationship – the true object of postphenomenological inquiry – could be present to be observed. Ultimately, this obstacle rendered interviews a less effective, less well-suited, method of postphenomenological inquiry, leading to their eventual cessation and further investment into the participant observation aspects of my research.

Lived Experience

In the both geography and philosophy of technology, understanding how technology mediates experience is central to explorations of human-technology relations (Rosenberger and Verbeek, 2015; Ash and Simpson, 2018). My research has sought to attend to the lived experience of archers and their equipment through both interview and ethnography, but primarily through way that embodied

participation is at the centre of my approach. Whether participation is necessary to get at lived experience is a contested issue. Merriman (2014) argues that other methods are able to interrogate lived experience and that the belief otherwise stems from a false conflation between proximity to an experience and authenticity in reporting this. Merriman calls this an "illusion of 'first-handedness'" (pg. 176), and others have similarly spoken against the position that experience cannot be accurately conveyed through oral or textual methods (Dewsbury, 2010; Hitchings, 2013). Yet, participation undoubtedly does facilitate researchers' sense of immersion and empathy (Spinney, 2015). Leon Anderson (2006) discusses the notion of a 'Complete Member Researcher' – whereby the researcher is as committed to the practice as the other participants – as being a means to approximate the thoughts and feelings of participants. Although he recognises limitations to this, such as Strathern's (1987) argument that researchers will always have a second (research) identity that other participants lack, Anderson believes that understanding emerges "not from detached discovery but from engaged dialogue" (2006: 382). Methods which involve participation enable researchers to interact with the processes and experiences of their participants in a way that other methods may not. This does not mean other methods cannot attend to the issues at all, merely that they would not as readily respond to the postphenomenological imperative to capture concrete examples of human-technology relations (after Ihde, 2009). Furthermore, while participatory methods may not be unique in their ability to engage with lived experience, by establishing empathy they can enable researchers to better understand their participants. Researchers who have not shared in the experiences of their participants to some extent may not know what questions to ask or fully appreciate the answers that they are given. During my fieldwork, I found this to be the case in several instances. Descriptions, for example, of aches and pains were all the more visceral for me having felt them myself.

Ethnographic methods blur the boundary between field/non-field in ways which I have already discussed the importance of. But, like others conducting ethnographic studies of skilled practice, I found that my research was not limited to the spaces of the practice itself (Green, 2011). Instead, they overflowed into social events which were nonetheless essential to archery's sense of community, which in turn shaped archers' experiences of the practice. To fulfil the postphenomenological imperative of getting at the lived experience of archery, one must recognise how it is imbricated into broader social and material worlds. By contrast, interviews offered moments of reflection, a distinct dis-location from the 'doing' of archery which allowed participants to discuss broader patterns to their experiences. The combination of the two allowed me access to the moments of experience, where I could capture their viscerality and participants immediate reactions, and a more considered discussion, where these experiences could be situated in the broader histories of each archer-equipment relation.

Conclusion

As with many facets of postphenomenologies, there is no one 'postphenomenological method.' There is no singular way to approach research with a postphenomenological framework, but it is possible to undertake methods in a postphenomenological way. In this thesis, I have done this through methods that are well suited to discussions of materiality and lived experience in more-than-human systems. The postphenomenological framing of my work as sensitised me to the lived experience and materiality of my field site and drawn my attention to the relationships between actors rather than the actors themselves. Rosenberger and Verbeek offer a 'field guide' to do postphenomenological research (2015) and this analogy is well chosen; existing postphenomenological literature offers little in the way of logistical advice or training regarding *how to do* postphenomenology, but Verbeek and Rosenberger's field guide does offer insight into what postphenomenology should *look like*. An attentiveness to relations and mediation are at the core of postphenomenological research, but the means for achieving this remain unprescribed. It is for this reason that I suggest that postphenomenology should take a similar position to that which Lorimer (2008) proposed for non-representational theory – to shape and guide, but not determine, methods. The specific approaches to interview and ethnography that I have adopted in this thesis are postphenomenological through their focus on relations and mediation. Logistically, this has taken the form of exploring archery *in practice*, thus allowing the performance itself – and all its constituent parts, human or otherwise – to actively participate in my fieldwork.

6.8 Vulnerability and Researcher Identity

Conducting any kind of research can render the researcher vulnerable. We become vulnerable in the field as we expose ourselves to new ideas and experiences; we become vulnerable in the analysis stages through in-depth scrutiny of potentially traumatic topics (for example, Chatham-Carpenter, 2010); and we become vulnerable once more in the writing and publication stages through the exposure of our ideas and, in some cases, our 'selves' (for example, Ellis, 1999). Reflexive ethnography, and similarly participatory methods, bring this latter issue to the fore as the researcher puts themselves 'under the microscope' and 'in the public eye'. How researchers present themselves in their research needs to be considered along with how it might impact on personal and work relationships (Wall, 2008; Allen-Collinson, 2013; James, 2012). A common approach to managing vulnerability in these kinds of research is to acknowledge it – for example by combining fieldnotes

with “the researcher’s highly reflexive account of engaging with the research process” (Allen-Collinson and Hockey, 2008: 212). Confronting vulnerability should always be a part of any account of research. We must choose to engage with researcher vulnerability as individual and as institutions. The stigma of recognizing the personal costs of our research – particularly those raised through researchers making mistakes or facing ethical dilemmas – must be overcome. In this section I explore a select few of these moments, focusing on those that have stuck with me the longest. The truth is that during the year I spent in the field, and the years surrounding it, there would have been too many ‘moments of vulnerability’ to count – certainly too many to remember – on a scale ranging from minor inconveniences or disagreements to issues which called into question the feasibility of continuing my research. The mundane and commonplace concerns, such as dissatisfaction with my performance as an archer, are occasionally explicit in my empirical account. These were fulgurant inconveniences likely experienced by most archers and familiar even to those for whom archery is not. The issues I discuss here, however, are more subtle. At times they may have shaped my thinking and my approach without me noticing. Indeed, not only will they have shaped my experiences in the field and subsequent analysis of it but will likely have a profound role in shaping how I develop as a researcher.

The first moment of contention I encountered was one of identity. First and foremost, this was a question of identity. ‘‘Fitting in’ during ethnographic study is key. Ethnography is often a matter of social relations (Crang and Cook, 2007) and so the quality of the relationships established can directly reflect on the quality of the data collected (Schensul et al., 1999; Krane and Baird, 2005). But fitting in should not be conflated with being an ‘insider’. For many it is the later that presents the larger issue and receives the most attention. Recently, much of the attention on the notion of the insider/outsider researcher has been a challenge of the dichotomy (Milligan, 2016; McNess et al., 2013). For Arthur (2010) insider status is contextually constructed, one may be an insider at times and outsider at others as the field shifts around us. Others have taken this further to suggest that, given the variable status of the research, one can actively make decisions to situate themselves ‘in-between’ the two identities (Milligan, 2016). My position as an ‘insider’ of the archery community, particularly that of EUAC, was beyond dispute. By the conclusion of my fieldwork I had been an archer for six years, and a member of the EUAC for as long, making me the longest standing member and one of the most experienced archers. As a novice archer I had won my category in regional university competitions and placed 9th at the national BUCS competition in the outdoor season. For the academic year 2013/14 I had held the position of ‘Squad Captain’ at the club and was the regional coordinator for the ‘South Wales and West Universities’ League’ (SWWU). Through these positions I reshaped and restructured the league to nearly double the number of universities taking part and the number of archers able to be accommodated at the competitions. Although my role in doing so is likely long forgotten, these

changes have remained in place to this day. I was then elected to the position of 'Club Captain' (2014/15) – the head of the club – and in this position abolished two committee positions and created three more, two of which endure. During my time in the field (2017/18) I received the 'Captain's Choice Award' for 'contributions to the club.' For many the decision to give me the award was unexpected. My involvement in the club had decreased, falling short of the work of others, and even most of those at the end of their course joined the club after I had completed my term as captain. My contribution was a legacy, now little more than Ozymandias' vast and trunkless legs of stone standing in a desert. I had gained the (mostly affectionate) nickname "grandad" as a recognition of my relative age and tendency to talk about 'how things used to be.' This title, and the legacy hidden beneath it, clearly marked me as an 'insider' under the conventional binary, but also worked to 'other' me.

The result was that I belonged, yet did not fit in. The experience was haunting. Not in a melodramatic sense of acquiescing to the passage of time, but in the sense of the uneasy presence of a disquieting spectre. I could liken it to returning to a childhood home, overrun by a new and unfamiliar family – a sense of being in the 'right place at the wrong time.' This 'temporal disjuncture' was experienced as personal memory for me, and as a collective, narrative memory – written, oral, reliclike – for the rest of the club. The unease of this experience was only worsened by the dawning realisation that the spectre was me. *I was revenant.* My presence in the club "confound[ed] settled orders of past and present" (Wylie, 2007: 172) as I acted as a tangible anchor to its history. There were times when archers would tell me stories of the past, not realising that the acts they described were my own. I was "an unsettling complication of the linear sequence of past, present and future" (ibid) and this, rather than my position as a researcher, was the attribute by which I was most often identified. Actions taken to remedy the situation were unsuccessful – I was a spectre and the ability to unsettle is characteristic of the spectre. It does not fit in even where it belongs, because this is a matter of *when* not *where.* Attempts to assuage the discordant sense of identity it brought with it were likewise unsuccessful. And so, despite being an insider for the community, I could not claim to 'fit in' to my field. This did not create issues with access; so long as I was proactive in my engagements I was welcomed. Indeed, the ability to disappear into the side-lines may be an enviable trait for an ethnographer.

The primary consequence was not a 'conventional' academic one, but rather one that affected my ability to engage with my own research. At the outset, archery had been a hobby for me – a way for me to relax. Yet I had turned it into a site of work. In my research on autoethnography and serious leisure I had not read any similar experiences – despite it being one of the first things I now say to those wanting to research their leisure pursuits. It is not a matter of avoiding research on one's own everyday pursuits – which is a valuable area of research – but a matter of making a methodological

reflection, akin to a risk assessment. I found two solutions: adopting another activity to provide catharsis in lieu of the new field-site, which for me would have required an infeasible time commitment; or find a way to 'own' this misfit identity. I chose the latter, playing up to the identity. For me this abated the issue of identity, however it did not 'undo' it. My past position as 'fitting in' could not be reinstated and the consequences of engaging in research in a familiar space will likely continue to follow me for as long as I remain there.

An important point to draw from this experience is that vulnerability is not simply about the 'what' of the research – the ideas, the theories, the results – but also the 'how'. Neither my ethnography nor interviews directly attended to issues of identity, nor did I ever find myself in a position that I would have considered ethically comprising. Yet the process of conducting research itself – the act of manipulating the presentation of my identity to better fit into the field, of reflecting on my positionality, of critiquing my methodology and the questions I asked – produced a constant confrontation with my 'self'. These confrontations have helped me develop as a researcher and as a person, but they still maintain a characteristic rawness. At the outset of this section I claimed that it was necessary – for the health of academics and academia – to embrace researcher vulnerability. And yet, as I write I know that sections of this thesis – including this one – would be removed before I let close friends or family read my work.

6.9 Analysis and Dissemination

In order to analyse my data I produced transcripts of all interviews and fully typed up my notes from the field. I experimented with using the popular software NVivo for analysis, however found that the advantages it brought were outweighed by a combination of the learning curve and my own personal preference for more hands-on approaches. All interview transcripts were printed and coded by hand, however the sheer size of the field diary made this unfeasible, and so my ethnographic data was manually coded in Microsoft Word. In both cases a single run-though of the data produced some broad themes. These themes were then sub-categorised in an iterative process until I reached categories sufficiently refined to identify themes.

Key themes were identified from both sources of data and the literature and further data points were then organised around these. The process was both organic and iterative with a focus on immersing myself into the data rather than any sort of structured approach. At times I would re-play recordings of interviews while grouping ideas written on post-it notes and note cards. My approach to analysis

built on the idea of cognitive scaffolding (Clark, 1999), albeit largely coincidentally. The process of organising ideas and structuring them into chapters was largely a physical process of moving pieces of paper and post-it notes full of writing into a coherent argument, akin to re-organising Scrabble tiles into words.

As is often the case, my research produced far too many different themes to cover within this thesis (see Schiellerup, 2008). Those that were ultimately used were chosen because they most directly responded to the aims and, together, formed a relatively cohesive narrative across the empirical chapters. Through transcription, maintaining my field diary, and continued reading of the literature, these themes continued to emerge as I was conducting my fieldwork. The overlap between data collection and analysis helped me probe into themes as they emerged and, to a lesser extent, reduced the risk of hitting 'dead ends.'

Beyond the thesis, I have worked to produce several outputs to this research, these are discussed briefly here but in more detail in chapter eleven. Due to the experiential and non-representational roots of this research I have emphasised similar outputs. I have produced a series of posters which explore and demonstrate the key themes from within the thesis, these have then been displayed and presented as conferences and research showcase. One example was 'The Secret Lives of Technology' which sought to demonstrate everyday encounters with multistable technologies by creating a series of images which transformed depending on which pair of the corresponding glasses they were viewed through. Moving forward, I intend to continue to explore the experiential outputs of this research alongside more traditional forms of publication.

6.10 Conclusion

Overall, the style of this research prioritised a flexible, organic methodology which enabled me to renegotiate my approach as the project unfolded. The ethnography, interviews, literature, and analysis all fed into one another rather than taking place as individual streams. The result was a grounded project, where the key themes continuously unfolded throughout the course of the research.

Within this chapter I have outlined and defended the methods I have used by connecting them to the literature and the objectives of the study. I have identified possible weaknesses in my approach and stated how I worked to overcome these. Of particular importance are the ethical considerations that arise from doing research in familiar places/with familiar people. These, I have suggested, can be mitigated against but never removed. As is often the case with research, the reality of the fieldwork did not entirely match the original plan. However, I believe the flexibility of my approach enabled me to follow these meaningful deviations and get “down and dirty” (Charmaz and Mitchell, 1997) with the world I shortly move on to explore.

7. From the Ground Up: Creating the Archer as a System

7.1 Week One

The first thing you notice when stepping onto an archery range isn't the brightly coloured targets. It isn't the diverse selection of expensive bows nor their owners, laden with arrows. It's the emptiness. Depending on the range, vast swathes of it dominate the view. This gulf, between archers and targets, fills most of the room. On the range the beginners were training on it spans eight yards. In six weeks, they would move up to twenty. In six months, some will reach eighty. This emptiness is a transitory zone separating two points of consolidation: the archers and their equipment on one end, and the targets at the other. This flow is carefully managed, with signals used to indicate when – and which kind of – bodies may move past it. One blow on the whistle opens the range for arrows to be propelled towards the targets, a series of three blasts permits archers to cross and collect arrows from the target or, as was more common in this first week, the floor. Each signal overruling the previous. This is the language of the range, and it is a language predominantly spoken by the nonhuman actors present: the whistle, the range markings, the ebb and flow of arrows. Learning to understand this language and to situate yourself on the range is the first thing you learn as a beginner and the focus of this session.

However, the range extends beyond its physical presence. As a space it is multistable (Ihde, 1993), containing both physical and social dimensions. While these are intertwined, it is the latter that is most overtly considered as the session begins. As the beginners enter the room the range is already in place with the targets at the far end. They shuffle awkwardly around the unfamiliar space. *Can I stand here?* A crowd forms near the entrance and is only driven further into the room by the pressure building at the back by new arrivals pressing forwards. Despite receiving no instruction to do so, the targets are avoided. If the instructors have had time, a barrier of bows might form across the shooting line. Yet, even when absent, the logic of the range seems to call for a confrontational positioning of archers against targets. As the room fills, the eight members of the committee and three coaches move to address the new crowd. The gulf metamorphizes to a stage. It too gains a social dimension as those with authority are differentiated from rest of the group. The committee, elected the previous year to direct the club, have *de facto* authority. That is "they are seen to be *in authority"* (Lea et al., 2015: 71). By contrast, the coaching team have a "theoretical (*de jure*) authority" because they are "regarded as superior in areas of knowledge and belief" (ibid). The range begins to reveal itself as an ecosystem (Payne, 2018): as the committee talk, it becomes clear that they are not simply individuals with authority, but with *responsibility,* and these responsibilities are variously distributed across and

accumulating at specific points, places and people within the club The manifestations of their responsibilities differ between those with de facto authority and those with de jure, but both form part of Hand et al.'s "choreography of things and people in time and space." (2007: 680)

Through their responsibilities, members of the committee are points of the consolidation and crystallisation of tasks necessary for the continued functioning of the range. Taking the club's treasurer as an example, by managing finances *on behalf of the other members* the treasurer enables to the club afford to maintain equipment, purchase insurance, and pay coaches. If the position of treasurer were absent, then these responsibilities would either be left unfulfilled or distributed across the club at the cost of training time. Eccles and Tenenbaum have argued that a key feature of team play in sport is that, due to their distinct roles, not all knowledge needs to be shared evenly (2004: 548), by extension nor does responsibility. By consolidating responsibility these tasks can be carried out more efficiently while others are left to train undistracted. This fact is implicitly recognised within the sport itself. Archery GB's *Rules of Shooting* states that a good archer should always thank "the Target Captain at the end of each round *for work on his*[sic] *behalf*" (2017: vii, emphasis added). Yet responsibility is not just distributed across human actors. Indeed, the nonhuman components of the range are perhaps more significant.

To some extent it could be argued that the real purpose of introducing the committee is just to add credence to their own introduction of the range. It is the range markings and signals which guide the actions of archers throughout typical sessions, and they receive a greater attention at this stage than any member of the committee or coaching team with the possible exceptions of head coach and club captain. The focus of the introduction is on both the shooting line and whistle signals. Each is responsible for controlling the flow of archers and designating areas of the range as either safer or dangerous. One demarcates through space, the other over time.

The shooting line, here an unassuming piece of white tape stretching the width of the room, acts as a semi-permeable barrier for much of the session. Its purpose is to divide the range in two: on one side and in relative safety are the archers and their equipment, on the other lies the gulf before the targets – a zone of danger which the line forbids archers from entering. The management of the flow of archers could be carried out by an individual (human) actor. And indeed, a range captain is appointed each session to oversee the line's performance of its role. But this is only a small part of their responsibility. The line acts as the embodiment of an instruction. In Actor Network Theory Latour describes this kind of mediation as 'delegation' (Latour, 1993; Rosenberger, 2014). In postphenomenology it could be seen as either a background or hermeneutic relation depending on the specific engagement and, often, the individual's familiarity with its purpose. The semi-

permeability of the line is brought about by the fact that, even when human participants cannot pass, nonhuman ones can, normally in the form of arrows. In doing so it is the line which creates the gulf as a transitory space. Even those permitted to pass the line, at any point in the range's performance, are not permitted to linger. It is the shooting line which regulates the flow of movement on the range. With few exceptions things only pass one direction at a time: arrows towards targets, archers to collect arrows, archers returning to shoot, repeat. As such it enforces a structural linearity to the range. Beyond distinguishing different spaces, the shooting line is a liminal space it its own right. It is only when stood astride the line that the archer and equipment can negotiate it. Archers cannot simply shoot from one side to the other but must place one foot either side before shooting. This further emphasises the lines ability to command the range and defines it as a thing in its own right rather than as something constituted by the spaces it keeps apart.

Yet the shooting line could not function in isolation. It is the range signals – typically a whistle[20] - which opens and closes the range and so allows the shooting line to be traversed. In the language of Massumi (2002) the whistle de- and re-potentializes the range, reconfiguring it as either a space for humans or for nonhumans to traverse. By adding a temporal dimension to the range, the whistle signals further facilitate the management of the flow of archers in place of a human actor. However, as the whistle requires the direct interactions of a human actor it takes the form of an embodied relation for the user and hermeneutic relations all others. Specifically, it mediates the communicative ability of the range captain by enabling them to produce a high pitch signal which cuts across the background chatter of the range. Furthermore, the high pitch of the whistle produces a signal which is not only piercing but generally unique on the range, making its command unmistakable. But the whistle is not simply a tool of communication, it is a switch. It can only produce two meaningful signals – open (one whistle) or closed (three whistles). The simplicity of such a signal makes it one which the beginners can quickly learn to navigate.

The combination of the whistle and the shooting line builds a more-than-human ecosystem and creates a range which is not only a space to learn and perform archery, but a tool through which the learning and performance of archery can be facilitated. The establishment of authority condenses responsibility to specific points within this ecosystem enabling others to train unburdened, and the delegation of tasks to nonhuman actors creates an environment a human actor can "maximally exploit" to supplement their own abilities (Clark, 1999). As a result, beginners can quickly start to

[20] Some ranges use lights as signals, but these require additional equipment. At times when no whistle could be located the archers would use vocal commands, albeit often paying homage to the missing equipment by choosing to call "whistle" the appropriate number of times.

identify the key people, place, and processes of the range and start to navigate their own position within the whole system.

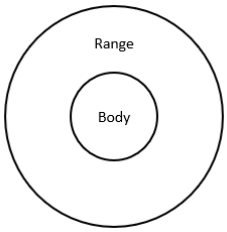


Figure 7 Diagram of awareness after week one

With the first week complete beginners have learnt to situate themselves on in the range. The focus of their attention is now extended beyond their body to incorporate aspects such as the shooting line and whistle signals.

7.2 Week Two

In their first week the beginners learnt to navigate the range. They were introduced to the world of archery by learning their place within it – physically and socially – and as they enter on their second week the consequences of this are clear. The awkward, out-of-place feel of the new archers has already started to fall aside as they organise themselves with purpose. They seek out their instructor and re-join their groups from the previous week. Some effort is still required by the coaches to wrangle any stragglers and to assign any new additions to a group, but there is nonetheless a resounding sense of something coming together. This week, sights have been added to the bows – a clear indicator of purpose. On reflection, the beginners may notice that the actual shooting they undertook during the previous week did little to develop any skill. Instead, it was a matter of acclimatising to the range and its atmosphere. This week that changes. The sudden appearance of the sight gives away the coaches' intentions for the week, and it is not long before the beginners are trying to align their sights with the targets. But learning to use the sight is not simply a matter of manipulating a mechanical device attached to the bow. The sight reconfigures the ways of viewing the range and so the new archers must learn to attend to new ways of seeing. Failure to do so may cause the sight to actively impede an archer's progress.

Ihde states that any technology which magnifies must also de-magnify (1993). As already outlined in chapter 3, the example of telescope allows him to explain that, while allowing the user to see further, it comes at the price of decreasing the viewable area. This principle is equally applicable to the archer's sight. The introduction of a sight focuses the archer on a specific point, consequently decreasing their awareness of everything else. As one instructor, Seto, observed, while focusing on the sight beginners often lost focus on their bodies at the detriment to their posture. Lessons which had previously been explained were forgotten, and a false sense of success was gained whenever arrows landed close to the centre. The addition of the sight was transforming the beginners' understanding of the expectations placed on them, as was clear from their discussions in their training groups and the reverence with which they spoke of the 'gold' and any archer who hit it. However, the emphasis in archery is on consistency rather than accuracy. This is even more true during initial training. The location of the arrows relative to one another (the 'grouping') is generally more important, and a better reflection of skill, than their location relative to the target face. However, the sight in combination with the target face had a noticeable effect on the beginners' desire to hit the centre rings of the target. We can attribute this to the imperative of the sight and target (Lingis, 1998). Lingis claims that "in the sensuous density of these things there are directives" (ibid: 77). We find these in the concentric circles of the target, and the overlapping ring of the sight. The very shape of the target,

and its bright coloured centre, calls for the archer to focus there. Indeed, the archery target is synonymous with accuracy. But it is the sight which compounds this. As Figure 8 shows, the sight is designed to match and overlap the rings of the target face with a simple, single point (the pin) to land in the centre. While the pin centres the sight, the plastic ring excludes the rest of the range from archers' awareness. It visually divides the world.

Figure 8 A target sighted over the gold.
The bright green pin marks where the archer is aiming while the frame of the sight (dark grey) frames the target.

To become a successful archer is to learn to navigate this divide and not lose sight of the wider archery system. A process of recalibrating (Noble and Watkin, 2010) the beginners' expectations is used to reinforce good habits while seeking to eliminate bad ones. The imperative of the sight must be resisted. A pure fixation on the centre of the target can produce a wide range of detrimental conditions extending from basic concerns such as poor posture, to more significant issues which are explored in later chapters such as target panic and gold shy. During this stage it is the former that is most prominent. As beginners' get to grips with the "complex 'material interaction'" (Dant and Wheaton, 2007) of aiming they learn how to use it to aim. The automatic response – to contort the body to re-centre the arrow – is not the most effective use of the sight and puts too much emphasis on the archer's body and too little on their equipment. Archers must also learn the appropriate timing to adjust the sight. Changing it too soon can 'correct' mistakes which cannot be resolved by re-

positioning the sight (such as poor posture or a bad release) while leaving it too late halts progress. Both lessons are interwoven as part of the way of seeing with the sight. One member of the committee reflected that they believed many instructors were "too quick" to adjust the beginners' sights and were doing it "too often". This, they felt, encouraged the wrong attitude by putting too much emphasis on just one aspect of the bow. When Laurier speaks of the "way that one sees as a barista" (2013: 132; see also Goodwin, 2000; Lynch, 2012) it is the navigation of these kinds of dynamic relationships to which he refers: the recognition and re-evaluation of different kinds of prompts. For Laurier it was the heaped coffee grinds, for the archer it is a matter of situating each shot within a broader frame of reference of posture, position, and technique as well as environment conditions and the condition of the equipment. It is a matter of recognising that the "way that one sees" as an archer is not purely about vision. The sight, rather ironically, is perhaps the piece of the equipment which embodies this best. Engagement with the bow is a multisensory experience, for the sight only works if the rest of the equipment, the archer's posture, and all other variables are within a tolerance.

Yet, as became apparent during my fieldwork, some struggled to include the sight into such a nexus of senses. These archers – perhaps less than a tenth of those present – found the sight impossible to comprehend. This appeared to be irrespective of the skill in the other aspects of archery. As one participant in Murray's study on prosthetics reminds us, "fitting a dead thing to your live body is and always will be an imperfect process" (2004: 12). Although the sight is not 'fitted' to the body in the same sense an artificial limb might be, the principle of an imperfect process remains. The body appears to reach a limit to its plasticity and the sight is rejected. Murray further highlights how one participant who was born without a left hand struggled to "even think left handed" when provided with a prosthetic (2004: 20). These archers founding the processes of adding, aiming and, primarily, thinking *with* a sight so 'unnatural' that they were unable or unwilling to learn. One participant reported that the need to recalibrate the sight left them feeling "frustrated" and that they "couldn't get [their] head around it" (Naomi, interview). The experienced archers amongst such respondents often described a sense of detachment from the practice when using a sight, as though its presences drew them out of the rhythm they had developed. Although the body can be "retooled" through training processes (Wacquant, 1995) these individuals remained resistant to the inclusion of the sight.

In cases where archers failed to incorporate the sight alternative modes of engagement with the bow were developed. While there are styles of archery which do not make use of a sight – notably longbow and barebow recurve – the beginners are initially taught Olympic recurve. In this style the sight is essential. Instructors are, when all else fails, permitted to switch to teaching an individual the proper technique for barebow. But until the issue is brought to the attention of the instructors the beginners manipulate the bow and sight to create their own 'work arounds' to functionally, if not physically,

remove the sight from the system. Just as distance does not restrict the possibility of something participating in a system (Hollan et al, 2000), proximity does not necessitate participation. Strategies brought to my attention largely consisted of ignoring the sight entirely or aiming off-centre to avoid adjusting it. Several archers I spoke to had started to aim off-centre because they struggled to understand the theory behind adjust the sight. If their arrows were falling too low, for example, they would compensate by aiming at a higher point on the target rather than adjusting the sight. As archers were rarely able to compensate in such a way with any consistent, it was detrimental to their performance in the long term. The attempts to circumvent the role of the sight – and the success some archers had in doing so – raises an important question regarding what it means to be skilled. Here we start to see skill as being communicative. The system produced results which would be associated with skilled performance when hurdles to communication between components were removed. While archers could not understand how to "read" their arrows and "respond" by adjusting the sight, their relationship with the bow was hindered. This notion will be discussed in more detail in the next chapter.

The rejection of the equipment is discussed in more detail in subsequent chapters, most notably chapters eight and nine, so my focus here remains on the changes brought about by the sight itself and their role in its rejection. As I have noted, the sight creates a divide which needs to be carefully navigated for archers to develop any great skill. The ways this happened were, for the most part, unique to each archer but the overall pattern was consistent: those who either learnt to use the sight or had it removed normally progressed, whereas those still struggling to adapt to its new ways of seeing saw their development hindered. Several did not return for the third session.

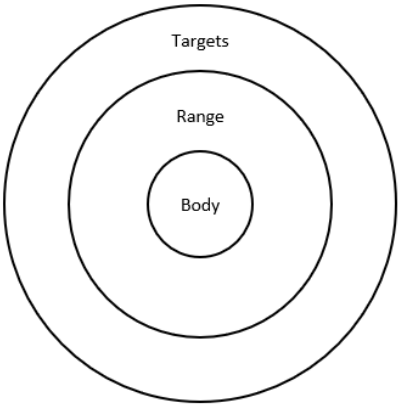


Figure 9 Diagram of awareness after week two.

With the introduction of the sight the targets become part of the archer's attention. Previously, even if present on the range they were largely absent from focus. Now they have purpose.

7.3 Week Three

To an inexperienced observer it may appear that little has changed as we enter the third week. The equipment and range have already been introduced in the last two sessions and, while the beginners are evidentially becoming more competent, there are do not appear to be any drastic paradigm shifts. Yet changes have occurred. They are subtle, they are slight, and, most importantly, they have little to do with the beginners. The point of interest for this session is not so much what is learnt, but how it is taught. The instructor's guides – produced by the coaching team – inform them that this week they are to be emphasising the correct placement of the hand on the riser. The 'gripping' of the bow is an essential skill no matter the bow style, and one that even experienced archers struggle with. It is not only a process of learning, but also one of unlearning. As one of the two points of direct contact with the bow[21], the location of the hand on the riser has a considerable effect on the path of the arrows. Gripping the bow too tightly or at the wrong angle can lead to arrows flying unpredictably and inconsistently. Given this, and the fact that it is an area with which beginners often struggle, there is a need for clear communication between beginners and their instructor. However, the difference between a correct and incorrect position is slight and to convey it verbally would require a specialist anatomical vocabulary – something neither the beginners nor instructors can be assumed to have. Thus, this session requires a more nuanced approach to teaching. This took the form of gesture.

The use of gesture as a form of communicating archery technique is by no means limited to this session. It is one of the most prominent tools the instructors deploy, but it finds a special place in this session by virtue of it being nearly impossible to convey the information through verbal means. This, again, is not unique to archery. A central aspect of teaching embodied practices is the need to overcome communicative difficulties. The combination of precise moments and fluid movements both practiced until they become routine, creates a performance which is more readily characterised by affective sensations than logical instructions. This tacit knowledge, as Lea (2009a) identifies, is central to much of the geographical literature on embodied skill. It refers to the notion that we "know more than we can tell" (Polanyi, 1966: 4) and has been described as "mundane frame of reference" (Watson, 2006: 208) and as "fundamental to all human knowing" (Küpers, 2005: 114; Polanyi, 1958). While the similarities with non-representational theories are evident Ingold (2018) identifies that tacit knowledge is not resistant to verbalisation. Instead, he claims it is explication which is insufficient. Explication requires "the twin operations of specification and articulation. Specification pins things down to fixed referential coordinates, articulation connects them up" (pg. 159-160). Tacit knowledge,

[21] The other being the string

therefore, is better described as a "process of knowing… a capacity to act" rather than a "resource" (Küpers, 2005: 117). In short, we can consider explicable and readily articulated codified knowledge as 'knowable' and the processual, personal, and performed tacit knowledge as 'doable.'

This issue, therefore, comes about with the conveying of something which is done rather than known. It is here that gesture reigns. The use of gesture overcomes the need to convey the detailed specifics of hand position by avoiding it altogether. Instead instructors provide "a gesture with which the student needs to experiment" (Lea, 2009a: 467). Another one of archery's key tenets explains why this is possible: there is no single "correct" technique. Instead it is about finding what is most comfortable and easily repeated for each individual. The technique is therefore very personal. As one instructor, Seto, explained "it's what works for you [sic]" (Field diary entry); were he a philosopher of postphenomenology he would have likely said that an archer's technique is multistable. Gesture then is not a straightforward method of communication. Rather it is a prompt for idiosyncratic experimentation, an opportunity for the student to find their own ways of navigating the confluence of bow and body. The beginners' attempts to incorporate a gestured action into their performance is then responded to by further gestures. From this a complex dialogue emerges (Downey, 2008b) which rarely, if ever, makes use of verbal explanation. While the intention appears to be to align the position of the beginner with that the instructor gestures, this is not quite the case. The gestured prompts serve to open the beginner up to the corporeal and more-than-corporeal aspects of the practice rather than to directly pass on skills (Adams, 2018), it serves to encourage them to find their own patterns and rhythms.

During the course gesture was not deployed solely for the purpose of communicating what needed to be done, it was also used to communicate what archers were doing. In this form it acted as an extension of the archer's proprioceptive capacities (following Alač, 2005), thereby reiterating the role of the instructor as part of the broader archery ecosystem. During these moments, the intention was not to demonstrate the ideal technique, but to create exaggerated re-enactments of any mistakes being made to draw the archer's attention to something they might have otherwise overlooked. This was particularly used to convey what would happen if the archer gripped the bow too tightly or attempted to 'grab' it. Both actions would throw the bow out of place by a few inches, but the instructors demonstrations showed a wilder, more reckless 'throwing' of the bow across far more visible distances. This 'pantomime' (Downey, 2008a: 2) brought the body back into focus and, short of recording someone shoot[22], were the best way to show someone what it was they were doing wrong. One instructor, Wilson, described this practice as 'mirroring'. When mirroring was undertaken without

[22] A technique which was used, but sparingly.

exaggerations beginners would struggle to pick out the aspects they were meant to be focusing on. Thus, the technique was rendered ineffective. However, mirror could also be combined with demonstrations of correct technique to create a more-than-verbal message stating: “you are doing this… but you should be doing this.” The ability to differentiate between the two enactments, not just repeat the correct one, was a core part of the learning process.

Throughout this process archery resists the binary of knowing/doing to establish an embodied knowledge. While this is not unique to archery by any means (see Beilock, 2008) a final example of gesturing demonstrates its prominence within the sport. Just as gestures are used by instructors to convey information to beginners, the archers use gestures to re-affirm information for their own use. In the beginners’ course and beyond, when archers needed to think through technique, they could often be seen to act it out. This links back to Alač’s (2005) notion that gesture and body language can be considered part of an extended cognition system. Here the movements act as a kind of extended somatic storage of memories – a literal muscle memory. By acting out the gestures experienced archers encounter them as a lively process, rather than as static and stale representations. In doing so they overcome the issues raised by explication (Ingold, 2018). The technique no longer needs be “pinned down” to fixed points, but can be remembered in its ‘true’, processual, form. As the beginners’ advance in skill they also start to adapt this approach. Some begin as early as the second or third week of the beginners’ course, recognising that it enables them to re-assess technique and therefore learn without being constrained to the time they actually spend on the line with an instructor.

If skill in archery is understood as the ability to repeat the same actions in the same way – the *exact* same way – over and over again then it makes sense for the sport to favour embodied forms of memory, communication, and interaction. The emphasis on gestures grows from this session onwards as instructor try to target the finer motions in the beginners’ technique. By using a physical language, it is possible for archers to overcome the language barriers which would otherwise impede their learning. This is particularly true when the specialist terms are not directly of the sport (e.g. the parts of the hand) and so would add new and unnecessary dimensions to the learning process. An important lesson learnt from this week is the recognition of gesture and other processes as part of the overall ecosystem of the range. Just as the range markings and whistle signals played a part, gestures are instrumental as well. As we recognise the fundamental role of such processes the range appears a more organic, almost living and breathing, thing.

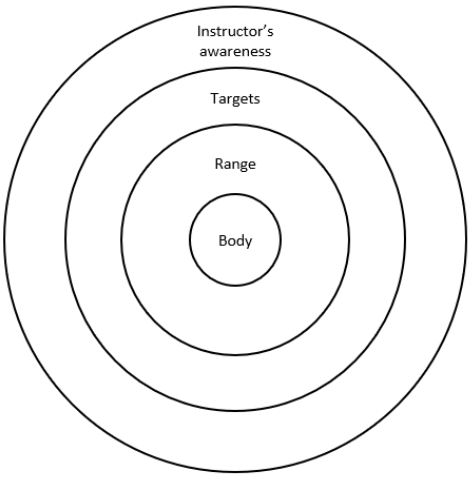


Figure 10 Diagram of awareness after week three.

While the instructor has always been part of the overall system, and has taken onboard some of the workload since the course began, it is in this week that the beginners become most aware that the instructor's awareness (e.g. senses) is directly imbricated in the whole process.

7.4 Week Four

Even assisted by communicative gestures, language and instruction are limited in extent and efficiency. No matter how innovative the instructor, they can only encourage and educate beginners to help them achieve the right postures and positions. A great deal of the responsibility for the performance remains with the beginner. Yet this can be problematic. Teaching was often limited by the beginners' understanding of what was being asked of them rather than the instructor's skill. As discussed previously, blind spots can occur. The fixation of the sight can lead to diminished awareness of the body, and full-body actions need to be seen from a distance to fully capture them as they unfold. The blind spots encountered in week four were far more literal. The focus of the week was on drawing the bow – a process which occurs primarily in the 'rear' arm and the back. Self-observation in archery is largely futile. If an archer were to turn their head to see their drawing arm, they would contort their body out of place, rendering the exercise pointless. Gestures help. They convey some of the important messages, but they reach their limits when the parts of the body being described lie deep under the skin (such as the trapezius – a key muscle for archers). In such cases, instructors turn to haptic forms of communication. In this session the methods of teaching become, to borrow from Crang (2003: 494), a little more "touchy-feely." Through these haptic performances, instructors extend the beginners' proprioceptive capacities by acting as part of the wider archery system.

Proprioception is the subconscious ability to sense the position of one's own body relative to itself. It is an essential part of all coordinated movement, but it finds a special place in archery. As the 'art of repetition' (Needham, 2006) archers must recreate the same actions for each shot. This means aligning the body as consistently as possible. "Absence, Leder notes, "lies at the heart of the lived body," but this absence must be navigated in the development of new skills (1990: 32). Leder argues that engaging with an unfamiliar physical activity requires – and often forces – us to bring our awareness of the body into the conscious domain. Yet even immediately after performing an action we are unable to recall it with precision (Downey, 2008a: 3). At times we use vision to 'error check' our actions. This approach is deployed in archery where plausible but that is often not the case for the unmediated body. Experienced archers were familiar with the problems this caused – they were not limited to inexperienced or low skilled archers. This made the precise control of the body an important skill in its own right. While it was taught in archery as a by-product of good technique, archers recognised that other practices might teach it more directly and those practitioners could transfer that to archery. One 3rd year archer remarked that "some of the best people to teach archery [to] are ballet dancers because they have such a great awareness of their body … if you say "move your hand this way by millimetres they can" (Rose, field diary).

The precise control described by Rose is not common amongst archers as individuals yet can be achieved through a distributed system in which the archer makes use of "scaffolding." The term 'scaffolding' originated in the work of Bruner who uses it to describe the way tasks may be pared down into smaller, more manageable sections while the instructor manages this process and carries out the more difficult elements "until such a time the learner is able to master his [sic] own actions through his [sic] own consciousness and control" (Bruner, 1986: 123; see also Downey, 2008b). As previously stated, where possible archers (and other practitioners) will combine visual and haptic methods to create a kind of multisensory triangulation to monitor their technique. Each additional sense can – albeit would not always – increase the accuracy of their awareness. However, in the case of the beginner we see the same combination of senses – sight and proprioception – but distributed across two individuals. The result is that the divide between beginner and instructor starts to become, in cybernetic terms, communicationally meaningless (Bateson, 1972). While it is still important to consider the way the senses are distributed, as this affects how they interact, we cannot readily distinguish the systems: each feeds back into the other. The instructor's role is to take on the responsibility of restricting the archer's possible movements (Downey, 2008b) through physical manipulation. By creating this scaffold to refine and correct the student's movements the instructor is enabling them to learn to recognise the sensation of being in the correct position. One instructor recounted that physical manipulation was a last resort method for them. This was predominantly because they, and the participants, were not always comfortable with the intimacy it required and also because of the risks associated with getting close to a drawn bow. However, they did also note that it was also a highly effective approach (Alexandra, interview).

Over time, the beginner becomes increasingly responsible for the coordination of their own bodies but, as is often the case in archery, there remains the possibility for equipment to mediate this. One key way archers can use equipment to facilitate correct posture with their drawing arm is by adding a 'clicker' to their bow. A clicker is a metal wire attached to the riser of the bow. It extends out just far enough to touch the tip of a fully drawn arrow. An arrow is then positioned under the clicker, pushing it out of place. As the archer draws their bow back the arrow keeps the clicker separate from the plate. Once the archer reaches full draw – which would normally indicate that their back is fully engaged and their elbow pulled back correctly – the clicker should slip over the tip of the arrow creating the audible 'click' that it is named after. This provide auditory confirmation that the body is in the correct position for the archer to release just as the instructor did in the previous setting. Much like in the first week this is an example of a process that could be carried out by a person being offloaded onto a technology. However, the clicker is not an unproblematic piece of equipment. It needs to be set up and calibrated and requires much of the archer's technique to be perfect to work as intended. For this reason, clickers

are some of the more high-end equipment and not provided by the club. No one was taught to use one of the beginners' course and those archers who did eventually attach one to their bow tended to be in their second year of archery or later. The clicker is therefore less versatile than an instructor who can focus on a broader range of issues and provide more comprehensive feedback. Compared to the clicker, instructors are more communicationally comprehensive and less specialised. However, both create alternative pathways for sensory feedback enabling the archer to better know the location of that which they cannot see.

As with the examples of Ihde's electron microscope (1993) or Rosenberger's Mars Orbiter Camera (2008), introduced in my discussion of postphenomenology, these mediating technologies transform one kind of input into another. Such mediation enables the archer to displace cognitive effort in two ways. The first is to off-load it onto a third party and the second is to increase the amount of information held by the system – i.e. to be able to identify, visually or otherwise, what is happening outside of their normal sensory range. Just as the electron microscope and Mars Orbiter Camera show, such mediation can cause information to be 'lost in translation' as it is converted from one form to another. The previous section acknowledged the limits to gesture which is previously why some instructors adopt more physical methods, but these movements are often one-way avenues of communication and the dialogue of learning can breakdown. Yet the process is not entirely intended to be a dialogue. Where the other methods described were predominantly to enable, physical manipulation is about restriction. Through the process of pushing and pulling their student's bodies instructors were morphing their worlds of possibility and reshaping their kinaesthetic senses. These transformations were not likely to be temporary (see Downey, 2005) but rather instilled new ways of being on the range and with the bow. Gradually, archers would become accustomed to this range of movement. The muscles they used to do so would develop, and they would comfortably settle in the correct position. Even once the restrictions of the instructor were removed in later weeks, the correct movements were so ingrained that postures beyond these would be described as uncomfortable and unnatural.

As physical manipulation begins to become more commonplace the range seems to lose an element of gentleness. The relationship built between instructors and students facilitates the use of hands-on teaching styles which could partly explain why they are less frequent earlier on. These methods also point towards a theme which runs throughout archery – proximity. Historically, the power of the bow was in its ability to enable action over distance. Within the practice of archery, the control of distance – between archers and targets, strings and riser, equipment and shooting lines, ranges and spectators etc. – remains at the heart. So far everything has been done at distance. In this session that barrier began to breakdown between instructors and their students, but this theme continues into week five.

This session also sees the instructor painted more directly as a mediating ‘technology’ rather than as a vessel of information waiting to be imparted.

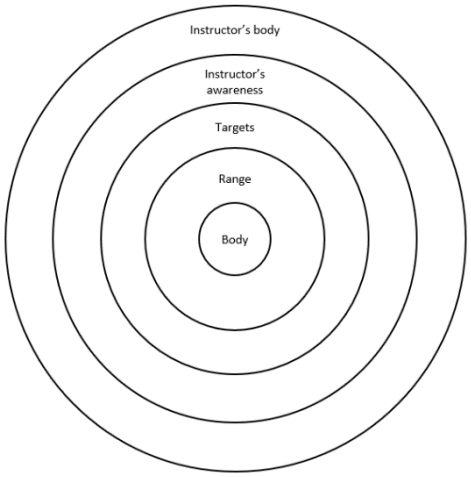


Figure 11 Diagram of awareness after week four.

Building on the previous week, the instructor becomes more overtly imbricated in the archery system. The beginner is ‘borrowing’ from the skills of the experienced archer. This change in awareness is not without irony – as their involvement becomes more overt, it also becomes less important. The increased awareness represents the beginners’ improved knowledge as they become more independent.

7.5 Week Five

The eight-yard range that the beginners have been training on so far is housed in a short, stout room which is crammed full even on the quieter days of the course. This week they find themselves on a full-size range – two-and-a-half times the length and perhaps eight times the width. The partially transparent, greenhouse-esque ceiling that looms fifty-feet above only adds to the pervasive and intimidating sense of this expanse. Emptiness was always a feature of archery, but without my glasses – glasses I rarely bother wearing in day-to-day life – the targets are nothing more than multicoloured blurs as the rings fade into one another. It is hard to immediately understand what is so disconcerting about the sports hall range. It is not just the sheer size, but what that size – and the room's configuration – suggests. The basketball scoreboard on the wall, while completely useless for archery, serves as a reminder that this is a competitive space. As does the viewing area which overlooks the range. Everywhere you look the warm comforts of the smaller, more crowded and relaxed range are displaced by reminders that sport is about competition, that scores matter, and that someone – maybe you – will lose.

There is no competition just yet though, and not all present will ever see one. This session – which beginners can attend in addition to their normal weekly one – is about scaling up the physical distances of the range in preparation for competition. In doing so it also decreases the social distances between beginners and experienced archers. With the first competition the club is entering barely two weeks away, and with subsequent competition almost weekly for the following two months, it is vital that beginners become comfortable and confident with these conditions. This is not just a physical adjustment, there are additional expectations in terms of adherence to etiquette and becoming conversant with competition structure and regulation. Scoring is a major feature this week, and another transformative technology. Just like the sports hall itself, the scoresheet transforms the meaning of archery. Where previously it was a cathartic hobby, the scoresheet renders archery a competitive sport. Beyond changing the experience itself, an idea which I will discuss in more detail in later chapters, it does this by changing the relationship between the archers. Instructors are still on hand to assist the beginners, but friends and fellow students are now opponents to beat rather than help. There is no sense of one archer wanting another to fail – the range rarely reaches any kind of hostility, a trait I've always attributed to the presence of the bows themselves – but more of a focus on individuality. Where archers had previously considered their shooting in isolation, they now find themselves ranked against others, implicitly if not otherwise. This adds meaning and purpose to their shooting as the beginners now have an overall objective to strive towards. It also adds a quantitative dimension to consider, yet at this stage none could readily judge whether their score is good or bad.

Yet conversations with experienced archers suggested that the judgement of their own skill was based on their opinion of their performance, rather than any comparison to others. This does appear to be in line with other studies (for example Windschitl et al., 2003; Kruger, 1999), suggesting that any fixation the beginners have on other beginners' scores is, at this stage, more about setting a baseline where no other exists. Until this stage, judgements on the quality of a shot have largely been made by the instructor and have focused on the process of the shot (i.e. technique) rather than its result. Here they are confronted with what was often seen as an objective valuation. In the process of moving up to twenty yards scores, naturally, dropped considerably. The muted clatter of arrows against a wooden floor as they rebounded off the safety net poised to shake the confidence of the beginners, but for me it was reminiscent of a mere four weeks ago (only eight hours of range time) when the same had been true on the shorter range. Although the beginners were moved up steadily – ten yards, then fifteen, finally twenty thus maintaining the scaffolding (Bruner, 1986: 123; Downey, 2008b) – the combination of a competitive focus and the full-sized range was a double blow for many who were quickly realising their previous appraisals of their own skill were hollow. Their stress was palpable: '*is this the purpose of session? To rob us of preconceived ideas of our ability?*' It certainly did not seem to be intended. Yet it created a sense of awe around the experienced archers who could effortlessly clear the distance with more accuracy than the beginners could at eight yards. This wasn't off-putting, it was a promise of possibility and potential. A goal for the competitive among them to strive to.

The creation of this goal is more than symbolic. It creates a new temporality for archery. Previously each shot happened in isolation. Any misses, while potentially informative and possibly disheartening, could easily be forgotten. The scoresheet creates a record, it gives the performance a past and a present and in doing so makes mistakes meaningful. Contrary to the other technologies encountered, the scoresheet is therefore not an off-loading of a cognitive task onto the environment[23] (Hollan et al., 2000). Instead, the scoresheet creates a new task and additional responsibilities for the archers. As a mediating technology, the scoresheet transforms each shot into information. These scores can be used to compare archers to one another, to measure development over time, and to check for issues with technique. Through the scoresheet a day might be considered "good" or "bad." But for the beginners it contributed to an ongoing differentiation between the "competitive" and "non-competitive" archers. This is a divide amplified by the second occurrence of the fifth week: the squad try-outs.

The squad consists of thirty-two archers, split almost evenly between beginners and experienced archers, but nearly three times this many people apply to join each year. The main criteria are

[23] Although it does achieve this as well by removing the need for archers to remember their scores.

commitment and enthusiasm in recognition of the fact it is still too early to tell who will progress to become a good archer. Yet, it would be hard to attribute the timing to coincidence. No competition occurs at less than twenty yards. An archer who struggled to maintain consistency accuracy over this distance would find themselves outmatched whenever competing. So, while learning to score and their first experiences of the full range are intentionally distinct from the attempts to join the squad, it does not appear to be so straightforwardly separated in their minds.

The fact that neither the scoresheet nor the twenty-yard range need feature in the squad try-out sessions shows the pervasiveness of their influence. They are framing devices which transform the practice through association. But this power can be destructive. Elsewhere I shall discuss how this influence can be understood as a pertinent signal which disrupts communication across the more-than-human system of the bow/archer. In doing so, the atmosphere of a competition has a visible consequence through the experience of the condition colloquially referred to as the 'yips' (Bawden and Maynard, 2001). I shall only briefly allude to this here, but the yips – more specifically described as 'target panic' in archery – is a result of the high-pressure experience of competitions. Importantly, once target panic has set in it is not limited to competitions, albeit it may be worse in such settings. Instead it functions much like any aspects of a learnt skill and takes considerable effort to overcome. It is not the intended consequence of the inclusion of competitive elements but is a direct result nonetheless. This is perhaps a darker side to skill development, but one of important note, and one which raises questions – and poses possibilities – for future research and training strategies. All of this is considered later.

This week is perhaps the most unusual for the archers. With the impending competition the pressure, and time commitment, is ramped up. Once the course concludes the beginners are reclassified as novices[24]. Novices compete in their own categories and so remain distinct from experienced archers in this aspect, but the other expectations placed upon them are much the same. This session is about bringing them up to speed and ensuring that they can fend for themselves, or at least not cause any inter-club issues, when attending other competitions. Although I have not discussed it at much length here, this session is also about bringing the beginners closer to the experienced archers in terms of preparing them to shoot at the same distances. In just a week all sessions will be open to all archers and, for the first time, beginners and experienced archers will shoot together. For this to run smoothly it is important to make sure that the full distance can be shot without problem, range etiquette and

[24] This term is used to describe any archer over 18 who has completed the beginners' course less than a year ago. After this point they are categorised as 'experienced'.

rules can be followed without oversight, and archers can recognise their own flaws and work towards resolving them.

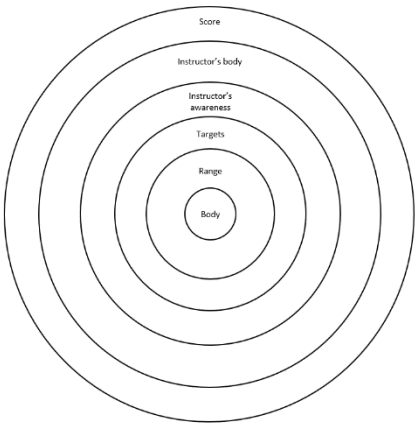


Figure 12 Diagram of awareness after week five.

As beginners become aware of their scores, they become aware of comparisons with other archers and with themselves. This allows them to judge their progress – for better or worse – and situated themselves within the club in terms of skill. It also allows a squad to be selected.

7.6 Week Six

As you enter the final session of the course it is natural to think back to the beginning. One difference is clear – the room is far emptier than six weeks ago. Perhaps only two-thirds of the original number have stayed. Some left because they found it too hard, others because it was too boring. Yet, when looking around at the session, I can't help but wonder if some left because it was just too repetitive. If our hypothetical external observer – last seen in week three – were to return it is likely they would feel much the same. Perhaps, should they look close enough, they would notice some developments. Beginners may be taking more control: placing arrows on bow, collecting them, and setting up the range. They may be less hesitant and choose to ask for feedback rather than awaiting instruction. The machinery of the range seems to be unfolding more smoothly. Yet much has remained the same. When Simon Needham titled his introduction to archery *The Art of Repetition,* he wrote an ode to the sport's most fundamental principle. *Repetition is the point of archery.* The word 'repeat' comes from the Latin roots '*re-,*' meaning 'back' or 'again,' and '*petere*' meaning 'to seek'. Repetition, then, is a matter of looking back, and a matter of seeking the same again. It is not coincidence that the nature of repetition comes to mind watching this session. As the final session it is given over to re-covering the previous material and assessing the beginners to see if they have developed sufficiently to shoot safely without supervision. Yet, despite the repetition, new things are learnt across the range.

Reflecting on the process of learning to play an instrument, Payne remarks that although "repetition might appear to be a prosaic activity … it need not be mindlessly mechanical" (2018: 110). Payne founds her claim on Ingold's argument that repeated performance and feedback enable a practitioner to gradually get "the 'feel'" of the performance and progress to a "rhythmic fluency" akin to that of a more skilled individual (Ingold, 2000). For Ingold, the process of enskilment is not simply 'iterative' but 'itinerative' – it is a journey (Ingold, 2000; Payne, 2018). Although each shot follows the same sequence, and although each session trains for the same result, the beginners' course is very much a journey. None of those completing it could be considered especially skilled but – as I was often reminded – that was not the purpose of the course. Several participants explained that the course aimed to 'teach people to learn archery'. It was a matter of setting the foundations for future, self-guided development by ensuring that archers could safely experiment with their own technique. As the 'art of repetition,' archery is about carrying out the same action in the same way – or as close to as possible – making the repetition here double: it is both the goal and the method of achieving it. This does not fit some of the earlier models of skill development, such as those proposed by Dreyfus (Dreyfus and Dreyfus, 1980; Dreyfus, 2001; 2002) which depict enskilment as linear and stable process. In doing so they imply that the process of refining skill is unidirectional and thus remain oblivious to

the slippages and reversals that occur in practice. As a result, any training program produced by implementing such a model may be ill-equipped to respond to them when they do occur. However, by appreciating that skill is processual and has the potential for volatility archers and academics alike have been able to develop a more nuanced appreciation of training and learning. Lea, for example, critiques Dreyfus' five-stage model stating that "there is no straightforward improvement or mastery of knowledge. Skill arises within situations" (2009a: 467). Payne turns her attention more directly to the unfolding of these situations by locating skill in an 'ecosystem' by using the notion of a 'meshwork' (Ingold, 2017b; see also Hunt, 2018).

Payne's notion of an 'ecosystem' models archery well due to its ability to appreciate the interwoven nature of people, processes, and things. It sees the process as being dispersed, precisely as has been described explicitly throughout this chapter, and implicitly as part of the beginners' course. The language of the ecosystem further lends itself to descriptions of how it is encountered. Ingold (2006) uses the process of walking as an analogy of skilled performance: "in walking, every step is a development of the one before and a preparation for the one following" (pg. 67). But just like a walk, one may choose to retract their steps or revisit a particular area. Walks, while journeys, are also *explorations.* Throughout the beginners' course the new archers have had a chance to explore the world of archery. Most key facets have been covered, including some that archers may choose to not encounter again. Sights, competitions, and potentially different bow styles have been visited, re-visited, and occasionally left behind. Like all journeys, skill development involves a certain amount of choosing a path and not all those explored can be followed. The instructor's brief recognises that the essential material has been covered by this point. Instead, it advises, this is a session for "fine-tuning" and re-covering material from previous sessions. The theme of this session, therefore, became one of de-, and re-, skilling.

Fine-tuning appeared to be a necessary process to close the course. Beginners who I spoke to often remarked that they felt that their shooting ability had been inconsistent from one week of the course to the next, this was exacerbated by the shifting focus. This session meant that beginners could go back to the points which they had moved on from too quickly. One participant, Sam, lamented "it's like I get told three new things I'm doing wrong each session" (field diary). Others shared this sentiment. This problem was inherent in the course's structure. The act of sedimenting learning – of building one lesson on another – leant itself to leaving some behind. Even those who managed to keep up found themselves with flaws awaiting correction. The restriction on sessions was implemented to manage the larger numbers and the need for one-on-one teaching but meant that some novices spent as much time on the range in their seventh week as the entirety of the beginners' course. This left the "rhythms and habits" which the beginners were developing "interspersed with disjunctures," which

Trentmann identifies as a common theme of routines and regular practices (2009). Ingold's walking analogy continues to state that, despite the fact that "the journey does have recognizable phases" which "lend a certain temporal shape to the overall movement" they are not "sharply demarcated" (2006: 67). The stages presented so far have been artificial, little more than an attempt to structure the course in such a way that it can be easily managed with the number of participants. But this final session represents a freedom from that structure for both participants and instructors. Now that all the material has been covered it can be re-visited within its full context. Some of this work is done within the session. The rest, providing the archer is safe – not good, just safe – to shoot is left for the archer to work out on their own.

As a final reflection on the role of repetition in archery and the beginners' course, we must think back to earlier weeks. Repetition – in the form of 'do as I do' gestures – has been an important part of the teaching methodology the whole way through. The process resembles a one of re-tracing another's footsteps. Although the path set out gives direction, it does not necessarily restrain. Room is still left for exploration. Now that the course is coming to an end, and the beginners are deemed safe to shoot independently as novices, they may stray from the hypothetical path almost as much as necessary. They have spent the last six weeks learning to find their place in the world of archery, now they have the opportunity to break away from this aspect of repetition and, through the others, (re-)create it in their own way. Orientation is over, and their adventure can begin.

And so, the beginner's course closes much like this chapter: with a focus on flaws, absences, and areas raised for attention. Not all the answers have been provided and there is much left to be explored. But a foundation has been built. The answers might not all be there, but the questions can now be formed. For those without any prior experience of archery some insight is provided. The course sets up the creation of a system but leaves participants and observers alike unaware of how that system is maintained, and what might threaten it. Each week has conveyed some part of a whole, but these parts cannot fully be themselves in isolation. It is only when the sixth week is reached, and the full practice is encountered as a whole, that it is truly experienced. Repetition and exploration are key parts of learning. They work together to let the participant become familiar with the experience on their own terms. Not all learn alike and none of the instructors are experienced teach, so as much room as possible is given for everyone to *learn* their own way while being *taught* the same way. With the course complete the instructors resume their normal shooting. The sessions open up to allow anyone to attend any session[25] and the club moves into its usual routine. But, just as the beginners' have observed their own flaws, the experienced archers have issues to attend to. With six weeks of

[25] Except for the two-hour squad session each week, which is only available to those selected for the squad.

limited shooting time following, what was for many, three months of no shooting over the summer, there is much to do. Perhaps the most important of these – particularly with the competitions looming ever closer – is to attend to all those things impeding the shooting. The fine-tuning used within this session to finalise the beginners' training now becomes a constant background process for the club. And so, following the archers themselves, I must now attend to the imperfections, disturbances, distractions, and entropic processes which work to unravel the skilled performance.

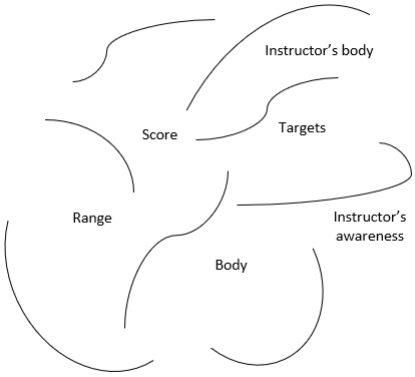


Figure 13 Diagram of awareness after week six (the end of the course).

> *As the final session ends the structure of the course is undone. It was always a false structure. The real environment of the range could never be so neatly contained or mapped. But such a structure provided a starting point for those unfamiliar to navigate from. Now the components of the course entangle freely, flowing in and out of relationships as necessary, and reaching out of the system where they can.*

8. Noise, Distraction, and the Limits to Skill

8.1 Introduction

The previous chapter established that the skilled practice of archery was not a solely human experience but rather a *more-than-human* (Whatmore, 2002) one. As such, it sought to de-centre the experience of skilled practice (Lea, 2009b) and (re)locate it within, and as, a "total field of relations … in a richly structured environment" (Ingold, 2000: 352). This perspective advocates for recognition of the agency of non-human actors, as outlined previously, and that skill is inherently tied to the ways these actors interact. Much of the writing on "ecological understanding[s] of skill" (Mann, 2018: 92) stems from the anthropological work of Ingold, most notably his concept of the 'taskscape' (1993) which has since been taken by Hunt (2018) and refined to specifically described skilled practice as a 'skillscape'. However, the notion of a distributed model of skill can be traced back to the cybernetics of Nobert Wiener and his work on anti-aircraft guns (see Rid, 2016). Wiener's work emphasised the importance of communication across systems and, in this chapter, I build upon this theme. Studies of skill have approached the matter from a wider variety of angles (Mann, 2018), yet discussions of task/skillscapes do little to interrogate how the connections between the various actors function. This chapter uses cybernetic theory – namely the concepts of signal, noise, feedback, and homeostasis – to present a model of skilled performance which considers the connections between things to be as, if not more, important than the things themselves when skill is concerned.[26] By reviewing how changes in these communicative pathways are imbricated in the performance of skill, I argue that skill can be understood as a measure of the communicative ability of a system.

Within this chapter I consider the system at a specific scale. I predominantly focus on three 'nodes' which group closely associated agents together: environment, archer, and equipment. Through their interactions, archery emerges as a "practised formation" (Lorimer, 2005: 85). While there are points in this chapter where it becomes necessary to further divide these nodes – to separate the physical equipment of the range from its affective atmosphere, for example – these three designations add consistency to the discussion and aid comprehension. As will become evident throughout this work, the archery system can be broken down in any number of ways and is fractal in nature – each system is comprised of subsystem which are, in turn, comprised of systems of their own. I have chosen to use

[26] Although, I do acknowledge that the way connections form is dependent on the things themselves, as is the subject of a latter chapter.

the environment, archer, and equipment as my categories based on the themes within the chapter. While they may appear to be reductive and artificial divisions, these categories and descriptors are drawn from the language used in archery, particularly when archers are trying to locate the cause of a problem, which is the focus of this chapter.

Of primary importance here is the concept of noise. Introduced earlier, noise is the "inarticulate, the confused mass of vibration, in which sound relaxes or dissipates" (Evens, 2002: 177). Despite the shared terminology, communicative noise is not limited to audible noise. It can describe any form of interference within a communicating system. For Zhang (2020) noise came in the form of distraction, exhaustion, and naivety; here I draw on examples of pain, hunger, and anxiety amongst others. Noise is predominantly perceived as an inherently destructive – if natural and a priori – force which we seek to exclude from communication (Serres, 1980; Gallagher et al., 2017). This chapter challenges these assumptions by building on the work of cyberneticians such as Gregory Bateson and Heinz von Foerster and drawing on the sociology of martial arts and sports psychology. Through their work, I explore how pain reveals the limits of a system and acts, as Evens has claimed, as the background and binding agent of communication (2002). This presents noise as a force which needs to be understood in context.

A focus on noise helps us to locate limits to skill, limits which are inherently geographical in nature. It is the role of material geographies, Anderson and Toila-Kelly claim, to question how liveliness is distributed amongst and across humans and non-humans (2004). Elsewhere, geographers have challenged the static nature of boundaries in skilled practices and their respective arenas, such as beachfront surfing (Sheller and Urry, 2004; Anderson, 2012), the rock-climbing wall (Barratt 2012) or fishing reservoirs (Eden and Barratt, 2007). In their studies of skilled performance geographers are achieving what Hayles (2006) criticised the notion of the cyborg (likely cybernetics' most prominent creation) of failing to do: providing an account of the more nuanced and subtle interactions between people and technologies. Just as in other practices, the limits within archery are diffuse. The lines drawn between active agents and passive observers are at best unclear. But there are also temporal limits that need to be acknowledged, and these are where an understanding of the role noise plays in performance stands to further our understanding of skill. Skill is neither static nor linear (Lea, 2009a). Even experts have 'off days' and bad weather can be detrimental to many sports. Skill comes and goes, even as practitioners learn and practice more. The reason for this ebb and flow, I suggest throughout this chapter, is noise.

Yet, as the experiences and actions of the archers featuring in this chapter go to show, the skilled practitioner is not without agency here. For each of the instances of noise that I discuss, I also explore

the steps archers take to resist its onset or make use of its presence. These novel approaches to training reveal insight into the role of noise in communication. The chapter is split into three sections. Each of these covers one overarching kind of encounter with noise: distraction training, tuning, and target panic. While noise emerges from and acts across the entire system, each of these does have a focal point on the environment, the equipment, and the archer respectively.

I begin by exploring the role of distraction training. This process acknowledges the myriad of distractions that naturally occur in the environment and so seeks to aid the system in developing a resilience against the most frequent. Through the concept of 'atmospheres,' this section argues that resilience emerges through familiarity with variation and provides potential for further study on the impacts of changing (and especially hostile) environments to impede skilled practice.

The second section looks at the process of tuning equipment. This is one of the more conventional forms of noise in that it relates, predominantly, to mechanical issues akin to those cyberneticians would have studied in the 1950s. Tuning is also one of the more natural instances of noise in archery, with the need to tune equipment rarely signalling any kind of issue with the archer or equipment. Instead, tuning is a matter of calibration and the need to ease communication between the various parts of the archer-system. This indicates that skill is trait which needs to be developed and nurtured, and that this can be achieved through more reflexive – and less human – approaches than considered in the previous chapter.

The final section explores the role of target panic. Target panic is a form of performance anxiety that occurs in archery. This form of noise exemplifies the uneasy divide between noise and signal. By situating target panic amongst the wider literature on performance anxiety in sports (the 'yips') I can consider the novel ways archers combat its presence through desensitisation. Target panic is a particularly personal encounter as, many years before my fieldwork, I experienced problems with target panic that I never managed to recover from, ending my competitive career.

8.2 Becoming Attuned to Atmospheres of Distraction

For me, sports halls have always conjured memories of cathedrals. Each brings vaulted ceilings, echoey acoustics, and the unshakable feeling of being watched. The sports halls used for archery ranges are no different. Elsewhere I have remarked on how absence is the most defining and most prominent trait of an archery range. Much – often the majority – of a range is empty space between the shooting line and targets. On the shortest range EUAC trains on, this gulf is eight metres. On the longest it is

one hundred and sixty-five. This is a traversable space, but not an inhabitable one. Arrows pass through when they are shot, and archers pass through to collect them again. The process repeats, but nothing stays. In competitions, even sound is barely allowed to fill this space. It is defined by permanent impermanence, dynamic stasis, absent presence. And so, I begin this exploration of skill as communication by thinking through how we might understand a space that juxtaposes itself, and what that might mean for the skilled performer acting within it. To do this, I begin with the concept of 'atmospheres.'

The concept of atmospheres, Anderson writes, is useful because "it holds a series of opposites … in a relation of tension" (2009: 80). Much like skill, atmospheres are experiential, processual, and distributed (McCormack, 2008). Although they emerge from bodies – of a variety of kinds and combinations – they become autonomous as they envelop us (Anderson, 2009; see also Ingold, 2011; Bille, 2015). Much like their meteorological counterparts, atmospheres enable mobility and provide sensory information (Ingold, 2006: Gibson, 1979). In both forms, atmospheres are a point of genesis and emergence: they provide conditions of possibility (Anderson, 2009). Given this, the link between skill and atmospheres cannot be understated. Indeed, if we did not already have an ecological perspective on skill, perhaps we would require an atmospheric one. Atmospheres have an agency, they 'press on' us (Anderson, 2009, following Marx, 1978) and in doing so potentialize and depotentialize (Massumi, 2002) actions. For Bille, atmospheres are the "haze" through which perception is formed (2015: 58, following Böhme, 1995). In the absence of much else – heat, noise furnishings – the atmospheres of an archery range play a powerful role in the sport. Their agency is something that archers must learn to navigate and attune themselves to. As I will proceed to show, even when detrimental to an archer's performance, the atmospheres of the range cannot be reduced to fit interpretations of cybernetic noise as a destructive force. They are vibrant and lively (Bennett, 2010) and the chaos they introduce to skilled performances may ultimately prove beneficial for the performer's development (Sternad, 2018).

Despite the prescriptive advice set out by World Archery (World Archery, 2020), there can be significant variation between archery ranges. Target distances, angles and sizes may be controlled, but there is an array of equally important variables that cannot be: temperature, acoustics, wind speed, reference points for aiming. A skilled archer needs to maintain their skill despite this changing environment and disruptive atmospheres (see Merchant, 2012). Tuning, as will be discussed later, is one part of this. Another is to decrease the reliance on variable environmental factors. Never, it was often joked, use a cloud as a reference for aiming, else you will find that your arrows gradually drift off target over the day. Yet, I often observed novice archers using treelines as a reference, only to find themselves lost when they shot a competition in a different field. These, however, are issues brought

about by a different kind of atmosphere and could mostly be overcome by better training. For those aspects that could not be so easily remedied, EUAC adopted different countermeasures. 'Distraction training' was an umbrella term used in the club to describe a diffuse collection of training strategies that focused on preparing archers to shoot in suboptimal conditions which included having archers shoot one-at-a-time, with the rest of the club watching, to replicate the feeling of being the last person on the shooting line and having half of the group create as much noise as possible while the other half shot. Distraction training as an explicit, defined practice does not necessarily take place at every archery club. Some felt that that it was redundant and should be removed, others saw it as a light-hearted alternative to training that helped build camaraderie and boost morale. I had previously used it predominantly as a less strenuous form of training in the sessions before competitions to reduce the risk of injury. Depending on which perspectives dominated at the time, the emphasis placed on distraction training sessions varied from year to year and committee to committee. However, the principles behind distraction training are central to the sport. We can understand these principles by returning to Serre's concept of the third man (1969). As was introduced in the literature review, the third man is the 'interlocuter' we seek to exclude from communication – the "prosopopoeia of noise" (ibid: 67). However, some distracting behaviour may represent a risk. Equipment breaking, intrusions onto the shooting range, and rebounding arrows may require shooting to cease for safety reasons. This meant that archers could not straightforwardly follow Serres advice and seek to exclude noise. Instead, they had to acknowledge the source of the distraction, process its importance, and then react accordingly. The majority of distractions could be dismissed, but the risks introduced by those that couldn't meant this response was far from automatic. Developing the ability to carry out this ad hoc risk assessment without damaging performance was the goal of distraction training.

Over time, as one might anticipate, archers naturally became more resilient to distractions and more experienced in responding to them. Dedicated distraction training was, therefore, a matter of dilution. Much of archery is carried out as tightly regulated 'set piece' actions, and these restrictions appeared to encourage an innate vulnerability to variation for archers. Distraction training artificially reproduces encounters with distractions, or noise, by inflating their magnitude/amplitude, and frequency. The distraction of a neighbouring archer talking on the line becomes a small group singing in your ear, the close proximity movement of an archer stepping up to shoot is replaced by deliberately obtrusive behaviour. Noise, here, is not simply a "demon" (Serres, 1968: 67) but an invasive species within the ecology of skill. To remove its intrusion is not just a matter of preventing entry in the first instance, but of weeding a garden in which it has already taken root. Furthermore, once set in, noise cannot fully be removed but must be made to 'matter less' (Sternad et al. 2014; Sternad, 2018). The nature of such intrusions is one of the fundamental reasons that skilled practitioners must work "emergently

and responsively" (Patchett and Mann, 2018: 23), remaining sensitive to the shifting circumstances of their performance. But, given that variation in circumstances is all but given in any skilled performance, familiarity with performing skilled tasks amongst the realities of a chaotic atmosphere is essential. Sternad (2018) calls these "nested redundancies," a recognition that slight (learnt and practiced) adaptations may be necessary to counteract naturally occurring variability. What we observe in distraction training, therefore, may be viewed as immersing oneself within the atmospheres of archery as a way of inoculating oneself against it. In other words, archers work to resist the effects of distractions by working to accept their presence as part of the range's atmospheres.

This concept of attuning (Stewart, 2011) is not unique to distraction training. An often-quoted tale in archery circles is that the South Korean[27] archery team will attend a venue before a competition to familiarise themselves with the range. I have never been able to verify this tale, but given the carefully prescribed requirements of a competitive range there would be little variation between them (with the exception of environmental conditions), eliminating most tactical benefits if viewed through conventional understandings of the range as an inert background to the practice. The need for archers to attune themselves to the range – or even just the willingness to believe such a story – not only highlights the archer's recognition that the environment is an active participant in skilled performances, but also an explicit acknowledgement that it is one that a practitioner can 'get to know.' Stewart talks about "an attunement to possibilities opening up" and recognising that these are "not necessarily good ones" (2011: 449) and ultimately that is what archers are seeking to achieve through distraction training and similar methods: a familiarity with the field of potential (Massumi, 2002) in which they perform.

The attunement referred to here, much like that described by Stewart, differs from 'knowing' in any conventional sense as it does not seek to pin down and restrain potential variables but rather remain open to the changes they may bring. As such, it better fits the understanding put forward by Ash and Gallacher (2014): that attunement "can be defined as the capacity to sense difference". (pg. 70). This perhaps is a recognition of the twofold impact of noise: the nounform and the verbform. The former refers to the distraction itself – the broken equipment or intrusion onto the range – an incidental factor that could not reasonably have been controlled. Attunement does not resolve this. The latter refers to *the act of becoming distracted*. Of letting attention wander, communication collapse, and the shot miss. Attunement, by opening the archer to the possibility of change, can act to prevent this

[27] Many apocryphal stories of training techniques are attributed to South Korea's team due to their prominent victories at international competitions.

from occurring. It is through this attunement that "variability no longer represents corruptive noise, but rather the expression of flexibility and choice" (Sternad, 2018: 4). This was particularly the case with intermittent noise during competitions, where the noise of the archery range did not fill its silence so much as overlap it - each amplified the other: silence let the sound ring out fully, unimpeded, while the stark contrast of sudden noise deepened the silence that encased it. The ability for atmospheres to overlap, yet not collide, in such a way has been described by Ash and Anderson (2015). Here, archers learnt to attune themselves to the silence, recognising it not simply as the absence of sound but as the potential for future sound. This means that archers need not 'tune out' noise, instead they learn to 'tune into' it.

Some forms of noise may, however, be more easily considered as natural variation than others. The distraction discussed above are, for the most part, distractions through intensity rather than their presence. Moments of loudness and quietness always exist on the range and only become problematic when they occur in unanticipated ways or for unanticipated durations. Some distractions can draw attention regardless of intensity. Here I move to consider the role of pain as a distraction in archery. I bring the experiences from my fieldwork into conversation with the concept of "forced reduction" (Green, 2011 to argue that the role of pain in disrupting a system is widely acknowledged but can be further developed through cybernetic interpretations of archery.

Beyond the aches of overtraining and exhaustion, pain is a rare phenomenon in archery. Unlike the martial arts considered in other studies on sports and pain (Spencer, 2013; 2012; 2009; Wacquant, 2004; 1995; Smith, 2008), archery does not involve direct contact with a competitor, and pain is not a goal. Yet, pain is not unheard of, particularly amongst novice archers. Many bear bruises along the forearms of their dominant ("bow") arm from where the string has caught them as the arrow is released. This pain is sharp – the force on a high poundage bow can be enough to break the skin – and sudden. Recounting one such incident, Maria notes how pain lingers beyond its felt intensity:

> "I hit my arm quite badly one time … [afterwards] I noticed that I wasn't shooting as I should be because I wasn't doing what- I wasn't drawing back properly because I was genuinely scared that it was going to hurt me." [Maria, interview]

The interview extract draws attention to the fact that the injury compromised the archer's ability to continue. Maria continues to explain that, following the injury, she stopped shooting for the session. Yet, the injury provided no real physical restrictions. There was no loss of movement or strength. The limitations took another form. Elsewhere I discuss how we can view this moment as a breakdown in the affective relationship between archer and equipment due to the equipment's agency in causing the archer pain. Here I focus on the breakdown of communications that results from the injury.

Bissell has described pain as possessing "the capacity to tear" (2009: 911), and in this example that is precisely what it is doing. Pain tears open pathways of communication and tears through the skillscape. Through its intensity, pain severs relationships (of all kinds) through a process Green (2011) calls "forced reduction". Forced reduction refers to the all-consuming nature of pain and is predicated on the view that pain is a process that demands attention (Bissell, 2009; Wylie, 2005) and one that subsume agency (Chare, 2005). That is not to say that Green (2011) depicts pain as an inherently negative experience. Like many other martial artists (such as Spencer, 2013; 2009; Smith, 2008; Wacquant, 2004; 1995), Green depicts the forced reduction of pain as being potentially desirable. It provides the opportunity for a single-minded focus on the task at hand (Green, 2011) and adds an additional level of difficulty, making eventual victory even more rewarding (Spencer 2013). For the context of archery, pain provides little benefit. Within the archery community, I was part of a small minority who rarely wore a bracer to protect their arm. I found that the plastic bracer often caught the string thereby causing an injury that otherwise would not have occurred and more frequently impacting my shooting. However, my experience with more combative martial arts may have prepared me to experience pain through "body callusing" (Spencer, 2009) that is not found in archery. Therefore, returning to the understanding that distractions are twofold – the obstruction and the shock – I was less impeded by the shock of pain. Maria's experience was by far more common, and throughout my archer career I have met archers who were so deterred by injury that they stopped shooting completely. This indicates that, while other sports prepare practitioners from pain, archery seeks to exclude pain from the practice and is ill-prepared for when this is insufficient.

Despite their differing perspectives on pain, Bissell and Green both agree that pain seeks to deny our bodies the ability to experience. For Bissell (2009), this occurs through a process of severing relationships and stifling enjoyment. For Green (2011), it is through the process of drawing all attention towards the pain. Scarry (1985), provides two spatial analogies to the destructive experience of pain: that the universe contracts down to the immediate vicinity of the body or that the body swells to fill the universe. Bissell's depictions of pain fit the former while Green's – despite his use of the word 'reduction' – is best described by the latter. In either portrayal, pain is a form of cybernetic noise which disrupts communication across the system by overwhelming the intended message (signal). This appears to leave the grounding aspects of pain (Spencer, 2012; Green, 2011) unaccounted for. This absence could be explained as a trait inherent to the practice of martial arts – or archery – itself and could indicate a need for further study. However, studies have found that skilled practitioners who focus on an unrelated, low effort, task (called "dual-task conditions") – such as counting in their head while shooting – perform better than those focusing on the practice itself (Maurer and Munzert, 2013; Jackson et al., 2006). Applying this concept to the depictions of pain in practice, we can begin

to understand pain as *noise overwhelming noise* as well as signal. Experiences of pain distract us from the other distractions we are experiencing (Green, 2011). This does not require us to re-interpret pain as being contextually destructive, but rather interpret destruction as being potentially desirable: pain retains its capacity to tear, but it tears our chains too. That is, if pain indiscriminately interrupts sensations, there is no reason to presume that all sensations interrupted would have been desired in the first place. The potential applications for counter-communicative processes, such as pain, in the development of skill are further explored in my review of experiences of target panic.

In summary, atmospheres of all kinds play an active role in the performance of skilled practices. While always ephemeral and evasive, practitioners can attune themselves to atmospheres even though the atmospheres themselves can never be truly captured. This is achieved by the practitioner opening themselves, and the performing system, up to the possibility of change to establish new communicative pathways between the atmosphere and the other participants. In other words, while atmospheres are intangible, the effects and affects they produce are not. Similarly, practitioners can attune themselves to pain through body callusing, although this is not done in archery. Body callusing, like other attunements, is not an act of 'blocking' sensation, but accepting its possibility. Through this, I have sought to show that skill is not a static process or rote repetition. It needs room to adapt to natural variations and training methods can incorporate cybernetic noise to allow for this. Skills developed in such a way may be more resilient to the impacts of noise as they establish redundancies in the communication between actors in the skilled system. Furthermore, in demonstrating that noise can play a role in skill development by being reconfigured as an additional form of communication I have begun to establish communication as a foundation for skill.

8.3 Tuning: Calibration in the Art of Repetition

Downey describes skill as the ability to "coordinate the body with the environment" (2008b: 211). Beyond the beginner's course, this process of coordination is rarely as explicitly in focus as it is in the process of tuning. Tuning can be understood as the archer seeking to establish alignment between equipment, environment, and themselves – a deliberate effort to solidify the communicative pathways within which I situate skill. It can be understood as a skill distinct from shooting. It is not covered by the compulsory beginners' course; any engagement in tuning is optional and, due to the requirement of a bow (or, at least, having sole use of one), is generally restricted to the more committed archers. In this sense, it is a deeply intimate process despite the often mechanical and seemingly impersonal external experience. Of those who actively tune their equipment, more are high

performance competitive archers seeking to gain any advantage they can. A further, smaller subsection is formed of those whose interest in archer leans more towards interacting with the equipment than the sport itself. This chapter focuses on the context of competitive archers rather than these 'tinkerers' whose objectives are less clearly linked to skill, and whose experiences fit better elsewhere. Where the previous section sought to show how variation can be used to strengthen the communicative pathways that form skilled practices, here I seek to demonstrate the importance of consistency. I show how tuning utilizes the concepts of noise, homeostasis, and feedback loops in effort to refine communication. By establishing that skill is maintained and developed through practices which maintain and develop the communicative pathways between components in a system I seek to further equate the two and locate skill as communication. First, I locate the concept of tuning in cybernetics.

Summarising Ashby and Conant's (1970) essay on system regulators, Pickering (2010) attends to two different approaches to feedback. The first, 'error-controlled', is "intrinsically imperfect" (pg. 150). Taking the example of the thermostat, Pickering shows how error-controlled regulators utilize negative feedback loops to return to a point of homeostasis by responding to deviations from the desired state, such as changes in ambient temperature. These systems are reactive and so there is always a lag between a trigger and the system's response. In contrast, 'cause-controlled' regulators are pre-emptive and – in theory, if not in practice – can achieve perfection if all variables are accounted for. For contrast, a cause-controlled thermostat would not respond to ambient temperature but would seek to predict future temperature using smart sensors to detect and analyse factors such as windspeed and sunlight. As a result, Pickering (2010) and Ashby and Conant (1970) conclude that a perfect cause-controlled system is plausible if the regulatory is "isomorphic[28]" with the system it regulates (Ashby and Conant, 1970: 89). Or, in the words of the eponymous theory they propose in their essay: "every good regulator of a system must be a model of that system" (ibid). Placing this in the context of archery, the archer strives to create a cause-controlled system. Variables are accounted for as far as possible and a perfect score is theoretically achievable.[29] Yet, the archer exists in a dynamic world where variables interact freely, and no perfectly isomorphic model can be created. As a result, archers fall back to acting as error-controlled systems despite seeking to be cause-controlled. Tuning, as a predominantly responsive practice, is one of the most tangible examples of this.

[28] In maths, two things are isomorphic (from ancient Greek *isos* ("equal") and *morphe* ("form" or "shape")) if they share a structure yet the elements are ascribed different names. Put simply, the connections and flows of information are functionally identical.

[29] During my fieldwork I witnessed scores reaching 597 out of 600, or 99.5% accuracy

Error-controlled systems are those that seek to eliminate noise to maintain stability. This stability – or point of homeostasis – both characterises them and make them a good model for archery. As the "art of repetition" (Needham, 2006), archery places similar emphasis on consistency and stability. For the archer, the point of homeostasis is defined by hitting the centre of the target. This is exemplified by an adage I was introduced to when I first began shooting – that there are only two skills in archery: learning to the hit centre of the target once, and learning to do whatever you did then every time. Considering the previous section, this claim is obviously problematic. It is an oversimplification which strips away the agency archers normally recognise in nonhuman participants. But it does serve its purpose: it is a, memorably pithy, reminder that the core of archery is repetition. Yet, following Bateson's (1972) interpretation that noise generates new information, we can re-interpret deviations from our point of homeostasis. An arrow that misses the centre of a target highlights flaws and inefficiencies in the systems – *it isn't the flaw itself*. These deviations are forms of noise which generate new information. A parallel would be submerging a tyre in water so that bubbles might reveal a puncture which can then be repaired. This is where tuning begins. Indeed, tuning is only possible because of noise, to the extent that – as a I discuss later – archers may seek to maximise noise to identify imperfections.

The ongoing process of adjusting equipment is an indicator of skilled performance (Allen-Collinson and Hockey, 2011; Merchant, 2012). Changes can occur to any part of it: the body can be injured, equipment can break or be replaced, environmental conditions for archery are notoriously capricious[30]. Following Merchant (2012), acquiring new skills can provide us with, or require of us, new body knowledges (see also Merriman, 2006; Lea, 2009a). These knowledges cannot necessarily be transferred in the ways discussed in the previous chapter (following Polanyi, 1966). Each is unique to the context of the individual archer, their equipment, and their current environment. While in the field I was told of an archer who had to adjust their string after every dozen arrows (in contrast to each time they set up the bow) because the changing temperature was causing the string to stretch unpredictably. The infrequency of this occurrence means a novice archer would likely have looked for the cause of the problem elsewhere – most likely believing it was their technique. But a familiarity with the equipment and various environments better prepared them to interpret the noise within the system. This points to the interwoven nature of what Lea (2009a, following Perrow, 1984 and Merriman, 2007) describes as the "tightly coupled" system of "bodies, techniques, objects, contexts, and knowledges" from which skill emerges. Tuning is only possible, and only necessary, because information passes between individual components of a system rather accumulating in any one skilled

[30] In my first outdoor competition, which lasted seven hours, I got soaked by rain leaving me cold to the bone, and then sunburnt. This is a fairly common experience amongst unprepared archers.

‘individual’. It is the process of ensuring that communication can effectively flow across the system and is never ‘mistranslated’. We can see this in practice by looking at aiming. The archer aims through an error-controlled regulatory system that uses previous shows as the primary information input. Yet a poorly calibrated sight would cause the arrows to miss the target even if technique and environmental conditions were perfect. This is a matter of intent not being transferred into action, a disconnect in communication. This is different from the sight being broken, these deviations would be measurably consistent. Tuning is where this measurement comes in, it provides a form of system diagnosis or debugging. Sometimes these deviations may be consistent and measurable but imperceptibly so. This is where archers embrace noise. Here I follow this theme to explore how noise-mitigating regulators are removed from a system to enable the archer to more easily identify the source of a deviation from homeostasis. In doing so I further explore the potential for noise to be used productively.

For many novice archers, the first form of tuning encountered is ‘bare shaft tuning,’ so called because it centres around the use of an un-fletched arrow. It is designed to calibrate the alignment between the arrow and bow to ensure that force is transferred from one to the other optimally. This process is not as simple as one might expect. The phenomenon known as the “archer’s paradox” (Park, 2011; 2013) describes how the arrow flexes around the riser of the bow due to its position relative to the bow’s geometric centre (Park, 2011). The arrow’s trajectory is noisy from the start. Figure 14 shows how a controlled amount of ‘wobble’ is introduced to the arrow which is negated as it averages out across its flight. The process of averaging out is facilitated by the stabilising spin created by the fletching of the arrow – these are the system’s regulators. However, if the arrow is not lined up correctly due to incorrect calibration, then the rotation facilitated by the fletching will be insufficient to smooth out the arrow’s trajectory. The result is an arrow which lands either high or low (if due to a vertical factor such as the nocking point) or left or right (if the issue is horizontal in nature, such as a misaligned pressure button and/or arrow rest). In either case, the divergence would be consistent so long as the cause was static (i.e. not caused by deteriorating equipment that worsens over time).

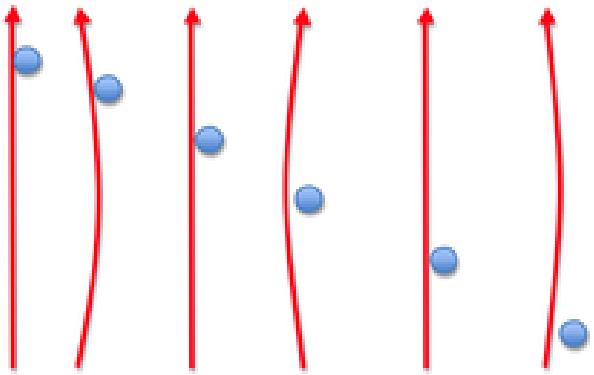


Figure 14 Archer's paradox diagram

The arrow (red) flexes around the riser (blue) as it moves forward. The centre of the blue dot is directly between the centre of the target and the back of the arrow.

The consistency of these divergencies means they can be modelled, and diagrams which explore the meaning of common patterns (such as Figure 15) make up the bulk of popular tuning guides (such as the tuning section of Needham, 2006). This presents a Batesonian interpretation of noise, one that views noise as presenting new information for the archer. However, noise can occur as almost imperceptibly small discrepancies: a difference of a few centimetres for each arrow can reduce a total score by a fifth on a standard 60cm FITA target face. Tuning guides use exaggerated images for clarity, but archers must differentiate between noise produced by misalignment and natural variation. This can be difficult, if not impossible, for any but the most consistent archer. Bare shaft tuning, however, offers a solution.

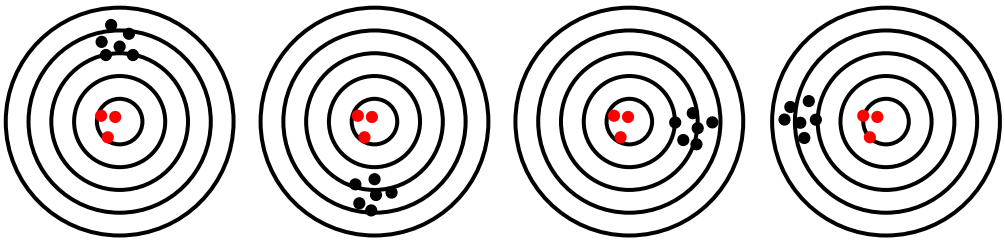


Figure 15 Tuning diagrams

The black dots represent where bare shaft arrows have hit a target whereas the red dots represent fletched arrows. From left to right, these indicate: nocking point too low, nocking point too high, pressure button too stiff (right-handed), pressure button too weak (right-handed). Horizontal variation is mirrored for left-handed archers

For Ihde, technologies which magnify also de-magnify elsewhere (1993). Just as the telescope increase our vision while restricting our view, fletching increases our accuracy while reducing the amount of information each shot provides. Fletching doesn't just mitigate against noise but insulates us against the "rawness of nature" (Taylor, 2010). Taylor uses the concept of visceral insulation to describe the distancing (physical, social, and affective) between people and killing, particularly in the context of hunting and meat production. He argues that technology detaches us from aspects of messiness in the world (see also Hayler, 2015). While Taylor's application is significantly more *visceral* than one would hope to see in target archery, the root proposition remains true. If noise generates new information, then noise-mitigating technologies indiscriminately restrict information as well as noise. This interpretation is more in line with the general use of the term found in Hayler's (2015) work. Returning to the early understanding of the act of hitting the centre of the target as a homeostatic point which the archer-system seeks to preserve and/or return to, then the noise-mitigating nature of the fletching limits the potential for extreme variation (see Figure 16). But by drawing variations towards the centre of a natural distribution, irregularities can be hidden. It is only by removing the fletching and exposing the system to the full extent of the noise that variations previously measured in millimetres are revealed to be significant inaccuracies. As a noise-mitigating technology, fletching is designed to limit the impact of unavoidable factors – such as the archer's paradox explained earlier – rather than repairable misalignments. However, their indiscriminate censoring obscures important information that the archer needs to calibrate the relationship between archer, equipment, and environment. However, bare shaft tuning must seek to avoid introducing new forms of noise which can skew results. The arrows used should ideally have never been fletched to avoid residual glue creating drag that would not be there otherwise and should have a measured amount of tape added to the rear to replicate the total weight and weight distribution of a fletched arrow. Even in its 'raw' and un-mediated form, potential variations in these arrows are carefully controlled.

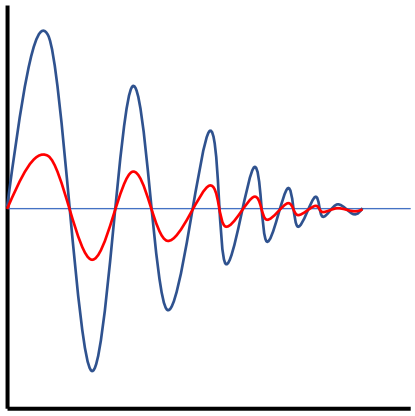


Figure 16 Fletched arrow vs. bareshaft comparison

If the central line indicates a forward trajectory the two waves represent the variation in the horizontal and vertical position of the arrow as it travels down the range. Assuming the bow is correctly tuned, the variations average out. The blue wave is an unfletched arrow, the red is fletched. If the equipment were not tuned the waves would be shifted up or down.

While unhelpful when the objective is to obtain the highest score possible, these raw variations are productive when the objective is ensuring efficient alignment of the various components of the system. Imperfections are highlighted and can be remedied. Error-controlled system function by responding to divergence from the homeostatic centre, and but show signs of diminishing returns as the approach perfection (Pickering, 2010). Thus, we can anticipate that the greater the divergence, the more able an error-controlled system, such as that seen in archery, is to attend to them. It would be inaccurate to claim that this is an instance of noise being purely constructive. But it is productive, in so far as it produces new information, and transformative. Yet, if we were not in the process of tuning, then it would be difficult to consider these variations as anything other than destructive. This further demonstrates that noise cannot be readily ascribed positive or negative associations and continues to indicate the need to recognise a reflexive level of maintenance to skill. By producing new information, noise provides an opportunity which archers require certain knowledges and experiences to optimally utilize. Should they lack these knowledges and experiences, it is possible for an archer to mistune their bow causing further damage to the skilled system.

This section has sought to demonstrate the precarious nature of skilled performance. As identified in the previous section, there is a need for alignment between archer, equipment, and environment. Here, I have focused on the adjustments that need to be made to equipment to maintain this balance. This shows the skilled system as a dynamic entity, and one that can be self-regulating. While noise can be accepted as inevitable, per the previous section, and archers can develop strategies to ‘go with the

flow' of a shifting setting, this section has shown that they able to harness noise to their own ends. The generation of new information through noise is used to facilitate the maintenance of communicative pathways through which energy and information flow. This further demonstrates my assertion that skill is a matter of communication by showing that a breakdown in communication – such as poor calibration between parts of the system – is met by impeded performance. Considering this alongside the claims of the previous section, I have identified what happens when environment or equipment are out of alignment with the rest of the system, and what steps can be taken to remediate this issue. I now move on to the final section where I explore what happens when the archer themselves are the cause of misalignment.

8.4 Target Panic: Runaway Feedback and Overload

Broken equipment, poor conditions, and even the occasional injury are common experiences for the competitive archer. The consequences are visible, the solutions apparent: repair or replace, re-assess and regroup, rest and recover. Yet, there is a condition that evades such clear remediation and haunts the sport, an issue so sensitive it is considered 'taboo' in high-performance circles (Prior and Coates, 2020; Thomas, 2008). 'Target panic' (Kidwell, 2004) is a sport-specific form of what is more generally described as the 'yips' (Bawden and Maynard, 2001). The yips themselves are a difficult condition to define, in part due to the fact they present themselves differently depending on the practice. Experience of the yips have been documented in golf (Clarke et al., 2020; Bawden and Maynard, 2001; White 1993), hurdling (McFarlane, 1990), trampolining (Clarke et al., 2015), darts (Bawden and Maynard, 2001) and cricket (Bawden and Maynard, 2001; Moody, 1993) as well as the playing of musical instruments (Ioannou et al., 2018) and writing (Quarterone et al., 2006). Efforts to provide an overarching explanation have reached mixed success. Clarke et al. (2015) define it as a "psycho-neuromuscular impediment" which hinders fine motor skills during the performances, but they limit their definition to the realm of sports. Drawing together the breadth of studies, it does become possible to create, if not a definition, at least a checklist. Drawing on the works of Bissell (2012) Smith et al. (2003)), Bawden and Maynard (2001), and McDaniel et al. (1989) the characteristics of the yips can therefore be said to include: *duration* – the condition must be long lasting and not an 'off day,' *impaired motor skills* – thus may not affect a practitioner's ability in an entire practice but only emerge where movements require precision, *skill deterioration* – the yips may only affect a skilled practice so there will be noticeable deterioration in the ability to perform, *pressure induced* – the onset of the yips occurs (and re-occurs) in moments of intense pressure as a form of performance anxiety. These

characteristics mean that the risk of experiencing the yips is not equally distributed. A complete novice would be unlikely to have the skill level to lose, and a non-competitive archer would be unlikely to experience the anxiety-inducing pressure required.

This checklist provides the basis through which this chapter will seek to develop a cybernetic interpretation – and definition – of target panic. Throughout this section I seek to explore and explain the yips as over-stimulated, or "runaway," positive feedback loop which overwhelms the skilled system. Whereas the previous discussions have focused on noise becoming information, here I show that information can become noise under the right circumstances. This will further develop my explanation of skill as communication by demonstrating that overstimulated communicative pathways reduce the overall capacity of a system and lead to a loss of skill. Furthermore, this overstimulation cannot be readily located in any individual component of the system in isolation, although does appear to be centred on the archer themselves.

Despite the taboo nature within professional communities, target panic is quite common. One study reported that 43.5% of participating archers were classified as having the yips (Clarke et al., 2020) while others have claimed that up to 90% of archers experience it at some point for varying durations (Thomas, 2008). Three years before I began my fieldwork, I had my own experience with target panic. Five years later it remains. As with many other archers I have encountered, target panic led to a significant disengagement with the sport. For me, it presented itself as an inability to fully draw the bow before releasing. Most commonly I would reflexively release the string long before I was ready, but with intense concentration I could overcome this reflex and draw until I 'hit a wall' and found myself unable to draw any further. 'Powering through,' a phrase sometimes used to describe the act of forcefully drawing quickly to reach the anchor point before target panic would set in (itself a problematic approach), did not work either. When I did reach the anchor point, I would freeze, unable to release the arrow at all. These issues, which varied from mild (at casual training sessions) to extreme (in competitions) resemble the experience of the darts player Eric Bristow, who described finding himself unable to release the dart at one point in his career (Bawden and Maynard, 2001). Bristow's experience shows that overlap between sports is possible and indicates that differences may be more of a result of the variations in the mechanical processes involved in each practice rather than in affective triggers.

Bristow's mixed successes in future competitions, along with my own experiences, show the long-lasting impact of yips-conditions but also suggests that such conditions do not indicate a loss of skill, per se, but negating or blocking of it. There is no visible process of un-learning involved, nor are the moments in which skilled performers falter associated with difficult manoeuvres. For Bristow, and for

me, it was the simple act of releasing. Other archers have reported that they experience it the most when shooting on larger target faces (Prior and Coates, 2020). For golfers, the yips often arise when putting (Bawden and Maynard, 2001). This indicates that the yips are not about difficulty, indeed the inverse is potentially true. Yips conditions appear to occur when a skilled performer attempts a simple task under high pressure. During my field study one archer remarked that they preferred shooting smaller targets because there was less expectation to obtain high scores. Importantly, such tasks are those that would normally be considered as being completed without thinking by a skilled practitioner. Therefore, it is possible that the cause of the yips is an attempt to take conscious control of otherwise automatic tasks (Masters et al., 1993; Bawden and Maynard, 2001). As I move on to explore the experiences of members of the EUAC who experienced target panic, I keep the concept of 'conscious control' at the centre of my analysis.

One EUAC archer struggling with target panic, Simon, described his experiences of 'snap shooting' – a form of target panic where archers instinctively release the arrow as soon as a 'trigger' event occurs. For Simon, this trigger was the moment the sight lined up with the gold centre of the target, but archers can be triggered by the sound of their clicker as well as body position. This was problematic, as Simon would often release before reaching full draw or settling into the shot. Ultimately, he chose to change to shooting a compound bow, where the mechanisms of the bow limit the opportunity for a trigger to arise.[31] However, he recalled a moment when he shot a recurve bow again in preparation for teaching archery at a summer school:

> "For a couple of days, if I don't really think about it [snap-shooting], it's fine. But then when someone says to me 'oh you're not snap-shooting anymore' and I think about it, it comes straight back. (Simon, interview)

When prompted to consciously consider the actions he was taking, Simon found his target panic re-emerge. This indicated that the over-thinking and anxiety could be an underlying cause. The implications of affect and emotions in archery, as a short-term concern, were a frequent topic during my fieldwork. One archer, Sarah noted that

> "[there were days] where I can't shoot, it could be the tiniest thing. I'm slightly sleep deprived and I'm just not focusing properly, because there's a million tiny little details that you have to focus on to get the arrow in the right place. I think just the smallest thing can throw you off

[31] Compound bows are set to custom draw lengths which they cannot be drawn beyond. This point is called a 'backstop'. Theoretically a recurve bow can be drawn continuously until the limbs snap. In practice this means that the point of being 'fully drawn' is more clearly defined for compound archers, and they can't 'overdraw'.

like you're a little bit hungry or you didn't sleep well, or you've got this dreadful deadline in the back of your head*" (Sarah interview)*

We can understand these experiences through the concept of 'hyperarousal.' Hyperarousal refers to an intense sense of anxiety as the body enters a state of high alert. It is commonly associated with Post Traumatic Stress Disorder and panic attacks, but the term has wider uses which describe an ideal point of focus on a task after which performance is impaired. The relationship, modelled by the Yerkes-Dodson Law (Yerkes and Dodson, 1908) shown in Figure 17, reflects Simon's experiences well. The Yerkes-Dodson Law provides an explanation for why the yips occurs during moments of increased pressure as these are the times where the body would be producing adrenaline and where the practitioner would be focusing more on details – both factors which induce hyperarousal.

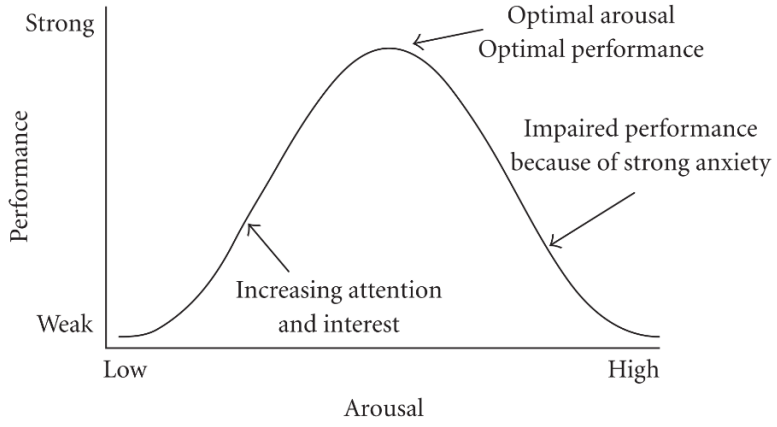


Figure 17 Yerkes-Dodson Law (Shresthsa, 2017)

Taking a similar perspective, Quarterone et al. (2006) describe the yips as being the result of an "excessive neural plasticity" (pg. 127), suggesting that these reactions could be considered akin to accidentally learnt reflexes. Bissell makes a similar claim, stating that we can view the experience as the emergence a new *unwilled* habit (2012). This would explain the long-lasting nature of the yips as, after a sufficient onset period, target panic would shift from being a scrambled form of the skilled practice to the practice itself. At this point it would need to be *unlearnt* rather than overcome, suggesting that the process is not entirely a process of moving forwards, but may in fact require established skills to be deconstructed. Evidence of a self-propagating nature to the yips can also be

seen elsewhere. Panic feeds back into the cycle (Bawden and Maynard, 2001) causing it to become more prominent when the finish line of a competition is in sight (Bawden and Maynard, 2001) or when an audience is present (Leary, 1992). In some sports, performers may have to complete a set number of actions correctly before the game can continue, such as bowlers in cricket, leaving practitioners feeling trapped by their mistakes (Bawden and Maynard, 2001). Sarah described a similar experience: "*It sorts of just spirals out into a fit of anger almost … it's gone down as a bad day and you have to sort just put the bow down and go back another day*" (interview).

Interpreting these through cybernetics allows us to consider yips-conditions as being linked to a positive feedback loop in which anticipation propels the performer towards a state of hyperarousal where they begin to focus on unnecessary cues such as their own sense of panic (Prior and Coates, 2020). But it is the underlying reason why hyperarousal is detrimental to a system which cybernetics is best suited to explain. The experiences described by Sarah could be modelled as a classic case of noise, an "interceptor" that "work[s] very hard to divert what is carried along these paths [of communication'" (Serres, 1982: 11). However, the difference arises from the origin of the noise. If the state of hyperarousal is characterised by a focus on task-irrelevant cues (Prior and Coates, 2020; Eysenck et al., 2007) then the noise is not coming from an external source but from within the process of communication itself. Returning to Simon's experience, we can see that it is not simply an autopoietic instantiation of noise, but a corruption of the signal itself. The collapse of communication occurs when more attention is placed on the transmission of the signal (as with conscious control). This extended period of hyperarousal sees the signal overwhelm itself – message is lost to magnitude. This is comparable to an overloaded circuit of deafening sound. As we recognise the breakdown in communication, we reflexively seek to repair it. We are, however, bound to fail. As the previous chapter identified, when archers are taught, aspects of the practice are brought in slowly and built up in sedimented layers. When, in the frenzied state of target panic, an archer attempts to do this they reach for everything at once and find themselves unable to decipher the information, further cementing the sense of being overwhelmed and propagating the issue. It is the difference between being immersed in one's practice and drowning in it.

Despite this, target panic is not unresolvable. If, as I have argued so far, we understand target panic to the be the result of a system overloaded by the intensity of the signal, then the solution lies in a process of desensitisation. This differs from the desensitisation seen in my discussion on distraction training through its internal focus. Simon, who eventually developed target panic in his compound shooting, describes one process of desensitisation:

> "[the coach] removed the pin which kind of calmed my sight down a little bit which helped me focus on actually looking at the target rather than overlaying a circle onto a circle … I had a fibre optic pin, so it was a really bright greeny-yellow and it was really prominent in the middle of the target. And the second you're off a little bit you felt like you had to move it … if you don't have the pin, it's strange, even if the sight is not centred on the target your body kind of does things and it gets the arrow to the middle just because your subconscious takes over." (Simon, interview)

This approach manipulates the mediating technologies (often the sight) to change the experience sufficiently to act as a 'reset' of the system. As noted earlier, target panic becomes akin to a habit (Bissell, 2012) and so requires an unlearning process. The act of making a significant alteration to the equipment, and therefore the shot sequence, provides an opportunity for archers to re-think and re-learn the sequence, making use of the notions of variation discussed earlier. Simon had previously approached this by changing to compound but, as it did for him, the issue can re-emerge as the system adapts and returns to its previous – non-functioning – point of homeostasis. This appears to occur when the 'reset' is not followed through to re-learn the skill. When Simon changed to compound, he stripped back the trigger for the problem but did not receive formal coaching. After the pin was removed, he was supported through the process by someone who could identify if the problem was starting to re-emerge and adjust appropriately.

The second form of desensitisation is to remove the trigger sensation entirely. The specific approach varies according to the archer and equipment available, but the underlying principle is to remove the target from the boss. This is called "blank boss" shooting (Prior and Coates, 2020), although some archers choose to create an X on the target with tape to retain some sense of direction while still freeing themselves from the agency of the concentric circles of a target which I have discussed already. Others opt to use black and white targets, blank sheets of paper, or just a bare straw boss. By removing the target, archers seek to break the feedback loop and prevent themselves from reaching a state of hyperarousal. Prior and Coates (2020) have criticised the approach, stating that when the target is returned – as it inevitably would be – then problem is brought back with it and promote solutions which treat the underlying anxiety. However, through the cybernetic interpretation blank boss techniques could still be used as a training aid. Using this concept, I have experimented with a series of coloured targets (Figure 18) which use different colour schemes to approach the problem in a different way, however none have been sufficiently tested to make any claims about their efficacy. I further created some coloured lenses using transparent blue acetate and thick card frames, with the

intention that the blue filter would make the gold appear black. These initially appeared to be effective, but similarly were not tested sufficiently.[32]

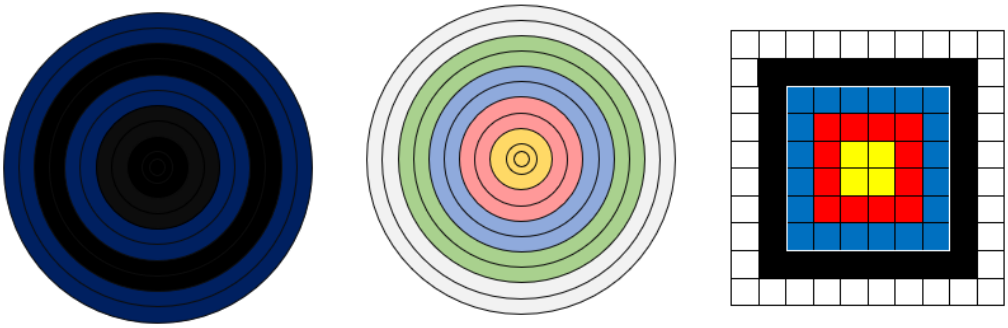


Figure 18 Sample targets for 'target panic'

From left to right: a standard target modified with a blue filter, a pastel-inspired low-vibrancy target, a grid target that avoids concentric circles. A full selection and explanations can be seen in the appendices. None of the targets have been sufficiently tested for verifiable results.

So far, I have identified two ways to remedy target panic. One focuses on the equipment, the second on the target or environment. The third approach is directed at the archer themselves. Like the others, this approach is a matter of deconstructing the system to re-construct it once the problem is resolved. In this approach coaches encourage their archers to break their shot sequence into individual steps and then work through these one-by-one, reciting them in their heads. As I observed earlier, one reason for the onset of target panic is the attempt to confront too much information at once, making it indecipherable. By breaking the shot sequences into steps, and encountering each aspect individually, we can avoid the overload that conscious control exacerbates. As such, this solution specifically targets issues arising out of a sense of being overwhelmed by the number of actions that need to be performed correctly. It may also assist by grouping simple tasks together, therefore reducing the apparent overall number. For example, 'position yourself on the line' may be the first step. However, this could also be broken into several smaller steps about aligning yourself with the line and rolling shoulders back. The former is helpful when trying to reduce the pressure on an archer, the latter can be used if an archer is getting caught up on a specific part of their technique.

In summary, the onset of target panic results from archers experiencing a form of hyperarousal produced by a runaway feedback loop through which the sensation of performance anxiety leads to

[32] However, since creating these I have discovered that blue-tinted lenses are sold for this precise reason in archery. A set of special glasses with six different lenses (including blue for target panic, and some low-light and bright-light lenses) is available for, at time of writing, £139.99. For comparison, my version cost about £2.

conscious control inducing a feeling of being overwhelmed which loops back to the feeling of anxiety. This can be paralyzing. As has been identified, target panic is a sport-specific yips-condition, suggesting that this interpretation may have applications beyond archery. While detrimental, target panic can be overcome if an archer engages with the right processes. A range of approaches are available, targeting the three core parts of the system – archer, equipment, and range – but each relies on the same concept of un-, and then re-, learning. When considered in the broader context of my argument for skill as communicative this indicates that skill is linked to the ability for a system to process the information that is flowing between it, and further defends the claim that a breakdown in communication leads to a loss of skill.

8.5 Conclusion

This chapter has sought to identify and locate skill in, and as, a more-than-human system. This follows calls from postphenomenology to see skilled practice as located beyond the notion of a skilled individual (Lea, 2009b). Using the notion of the skillscape (Mann, 2018) as a starting point, I have explored the limits of the skilled archer system through an observation of the impact of noise. I began by introducing the notion of distraction training, which showed how resilience can be deployed to limit the vulnerability of a skilled system, and how familiarity enables this resilience. This indicated that variation can, in controlled settings, be beneficial for archers and other skilled practitioners as it creates new and different pathways for more-than-human communication to occur. Under tested (i.e. competition) conditions, these redundant pathways lead to reflexive responses to changing circumstances or distraction, demonstrating a correlation between the extent of communication and the observable level of skill in an individual's performance.

The second point of focus was on tuning equipment. This section shifted from the affective and atmospheric viewpoint of distraction training toward a more mechanical perspective on archery. Tuning, despite being largely optional, would still be considered a core skill in archery – essential for any competitor or practitioner looking to achieve higher performance, but not for day-to-day recreational practice. This section showed how noise is excluded from the skilled archery system through mechanical components such as fletching on an arrow. While these components were perceived as protecting the system from the intrusion of noise (Serres, 1968), they also disguised the system's vulnerabilities. As such, tuning worked best when mediating technologies were stripped away as far as possible. The purpose of tuning – to ensure a consistent, linear correlation between the actions of one part of the system and the response of another – indicate a need for maintenance of

communicative pathways. It also suggests that a failure to attend to and nurture these pathways can place limit on skill development or lead to skill deterioration.

Finally, I turned to experiences of target panic. Target panic was understood to be a sport-specific instantiation of the yips (Prior and Coates, 2020), which is a term that describes the breakdown of a skilled sporting system. Drawing links between the causes and experiences of target panic and the solutions that archers implement, I argued that target panic was due to hyperarousal causing the system to become 'overloaded' with sensory information. As the symptoms of target panic and the other yips-like conditions present themselves in the practitioner it is often viewed as residing there. However, by viewing it as hyperarousal, we can see that it is in fact located in the communicative pathways, which become overwhelmed. This is experienced as a state of heightened anxiety, or an extreme form of choking (Clarke et al., 2020). This fits with broader theories on causes of the yips, particularly cognitive overload theories which attributes the yips to overwhelmed cognitive functions. The key difference being that cognitive overload locates the root of the yips solely in the practitioner, whereas the communicative overload interpretation distributes it across the communicative pathways of the entire skilled system. Furthermore, by linking the finite capacity of communicative pathways with the breakdown in skilled performance, this section established a clear link between the viability of skilled performance and the ability for various components to interact. At times where communication is blocked, drowned out, or otherwise halted, we do not see a steady degradation but immediate deterioration.

Drawing these points together, we can start to develop an interpretation of skill as not simply being distributed between actors in a more-than-human system, as per the post-phenomenological perspective described be Lea (2009b), but *as the distribution itself.* Taking this perspective indicates that future research needs to focus on the relations between actors in a skillscape, an area that I have previously noted is underrepresented in current literature. The direct links between the extent of communication and the skill demonstrated by a system support this understanding. Furthermore, it builds on prevalent notions of distributed agency and an emphasis on inter-action. For archers, this provides explanations for why noise affects the system in the ways it has been described throughout this chapter. It proposes that the breakdown of skill occurs either through the interruption of a communicative pathway *or* through a reduction in the ability for any given component of the system to communicate. This would include injury, broken or obstinate equipment, or inconsistent and unpredictable weather. By locating the agency across the system, a distributed interpretation of skill supposes that there are no specific points in which skill accumulates, but that it is always processual and an unfolding practice. This supports the notion that skill is not a static entity, and fluctuations in skilled performance can be explained by the ebb and flow of communication. This view of skill can be

likened to the functioning of a brain. Thought does not 'live' in the cells or neurons but occurs through the constant transmission of electro-chemical signals across a distributed network. Skill, like thought, is in a constant state of emergence as the system responds to external stimuli. This emphasises the versatility of skill, but also its fragility, which has been identified through this chapter. Much like with neurons, continued interaction between actors and contexts strengthens the connections and eases communication. This allows for skill to develop and for disruptions to communication to be overcome. However, these connections can be detrimental to performance – such as with target panic – and need to be deconstructed.

Looking forwards, viewing skill as distribution rather than distributed can help generate new training methods, new technologies, and new remedies for skill deterioration. Notably, it would put much greater emphasis on intuitiveness to technology. However, focusing particularly on the discussion on distraction training, it would also encourage practitioners to experiment and explore the role of variation. By placing additional emphasis on communication, future research can be directed to explore how more-than-human communication can be facilitated by exploring the mechanics in more detail. Future research could build upon this interpretation to reconceive of understandings of noise as inherently destructive, to bring together the various and varied interpretations seen across anthropology, sociology, geography, and psychology. Particularly, it could reconcile the contradicting depictions of pain discussed earlier.

Within this thesis, understanding skill as communicative sets the ground for further discussion about the relationship between archer and equipment. In this next chapter I move to consider how the relationship extends beyond mechanical utility to include affective and aesthetic relationships. A communicative basis for skill helps justify this interpretation by suggesting that factors which facilitate communication will similarly facilitate skill. For archers this can include customisability, sentimentality, and trust. By identifying these desirable traits, it is possible to build on the discussions of skill, from this chapter and the previous, to reconsider the design of technologies and teaching strategies.

9. Modelling Human-Technology Relations in Archery

In chapter four, I outlined an overarching theme to depictions of skilled tool use and grouped these depictions as part of a 'model of incorporation.' This term refers to a proclivity towards mapping the processes of becoming skilled with a technology as being synonymous with that technology being drawn into the user's body schema. Within such theories the body is viewed as being 'extended' and the technology is rendered 'transparent' while functioning as expected (for example, De Preester and Tsakiris, 2009). Within this chapter I begin by identifying how this model can be accurately applied to the context of archery, notably through discussions of what it means for a bow to feel 'natural' during use. I then critique these ideas as being overtly humanistic by drawing on the new materialist works of Jane Bennett, amongst others, and studies of animal companionship. The latter half of the chapter shift to propose an alternative model, one which is alert to the liveliness of the bow as well as the archers' recognition of this. I structure the chapter like this to demonstrate that, while I consider incorporation-based approaches to be limited, the model I propose is not intended to replace previous theories, but merely an attempt to acknowledge that there are multiple ways of performing a skilled relationship with technological artefacts. Thus, the model is not applicable to all instance of the skilled use of technology, nor even all performances of archery. Yet it does expand our horizons by offering a less anthropocentric approach to studying this particular facet of human-technology relations. I begin by returning to the model of incorporation.

9.1 Incorporation in Archery

For a practice to fit into the model of incorporation the technology in question must become more transparent as the user's skill increases. This relationship is proportional, albeit not necessarily linear. For a more skilled practitioner we would expect to see the tool, in this instance a bow, fade from the realm of conscious thought during the moment of use (Rosenberger and Verbeek, 2015). Discussions of transparency come to the fore in archery when archers speak of a 'natural' feel to shooting. As Naomi, a barebow archer with two and a half years' experience, this non-, or sub-, conscious facet of archery represented a specific level of skill development:

> "I definitely think I'm at the stage where I know what I'm doing, but I don't know it sort of 'brain wise' but I go by feeling. If it feels right, it'll be alright." (Naomi, interview).

Here we see an archer ascribe their movements to non-conscious thought processes – as would be expected as part of a process of incorporation – but also recognition that this a specific – later – stage in the skill progression of an archer. Within these descriptions, archers focused on sensory experience relation to feeling. Their relationships with their bows were considerably more tactile than visual, a fact that was exacerbated during when aiming at a target as the bow was out of focus. During these moments most archers spoke of looking forward to the desired point of impact, and while there were varied approaches to aiming and not all archers focused on a specific point on the target, there was a clear trend to participants losing (visual) sight of the core of the bow at the time. This can be contrasted with that practice of beginners, whose eyes can frequently be seen flickering towards the bow in an effort to check their bodily comportment. The gradual transition from visual to haptic 'body checking' represents a greater sense of the bow being included in the body's proprioceptive capacities. This shows both the body's extension, and a shift to "acting through" rather than 'acting on,' as Verbeek (2005) notes is a criterion of an embodiment relation – the postphenomenological instantiation of the model of incorporation. Naomi further emphasises the unthinking nature of interactions of the bow by stating that, during shooting, the bow slipped out of conscious awareness yet still retained some more-than-human communicative ability:

> "[when shooting] I don't think about it [the bow] … I know when the bow feels wrong … but I can't tell you what is wrong with it. I just know it feels wrong*."*

Yet a clear association was established between skill – or at least experience – and this sensation. As one experienced participant, Seto, observed "*the more you shoot the more natural doing things and moving with the bow becomes. So it feels almost like a part of you.*" Seto continued to discuss a sense of connection which, as I will explore later, extended beyond mere physical connection. His movements point towards something another participant noted – that the 'natural feeling' often described by the participants was itself inherently unnatural. It was a learned and constructed naturality, but also a discovered and negotiated one.

For Cole and Derry (2005) 'natural' is synonymous with 'unmediated' (see also Hasse, 2013) and so we can interpret that natural feeling, as described by proficient archers, to refer to the transparency of the bow. When Seto states that "the more you shoot, the more natural it becomes" he speaks of the bow becoming solidified as an extension of the body schema. This, for Hayler, is what distinguishes expert use from that of an amateur. For the expert, possible actions are encountered "by a body *augmented* by the equipment" (pg. 51-2, emphasis in original). This requires pre-existent modes of being and doing to be re-articulated as the body enters "new structural relations" (Cole and Derry, 2005: 218) as an array of different possibilities are de- and re-potentialized (Massumi, 2002). From

the postphenomenological perspective this occurs through the task and tool becoming embodied in the user; Ihde's example of a woodchopper is "constituted as woodchopper insofar as he embodies the axe … and is engaged in chopping a piece of wood" (Zwier et al., 2016: 318). The 'nature' referred to when archers describe a natural feeling must therefore not be confused with the sense of a pristine, naked or pre-technologized body, for the archer is constituted as an archer by the bow just as the woodchopper is by the axe. Thus, the natural feeling is something reached, not returned to. That is, the process of becoming skilled is one of becoming-archer. It is a process which is characterised by striking a new equilibrium in which practitioner's familiarity with the bow is sufficient to overcome and overwrite any sense of mediation to the extent that a bow's absence is more notable than its presence. One could say that this represents the bow being identified as part of the user's body schema and therefore an extension, as is described under a model of incorporation. However, it is the bow that drives the change by altering the range of potentialities available and framing future actions through a process Ihde calls "technological intentionality" (1990: 141). In the context of skilled performance, where the bow is actively guiding bodily comportment, we can think of this as the bow being designed with an "implicit user's manual" (Procee, 1997: 159) which users must navigate.

With this understanding, the training process becomes one of reconfiguring the sense of 'natural' to incorporate the bow. As such its eventual 'transparency' is not an incidental by-product of skill, but the very objective of training. In such moments, the new structures described by Cole and Derry (2005) function alongside, rather than entirely replacing, pre-existing ones (ibid). The archer maintains their ability to return to their previous configuration (by simply replacing the bow)[33] but while enacting the performance the reconfigured structure, which incorporates the bow as an active causal participant in the task, is more desirable. The process of reconfiguring the sense of the 'natural' is recognised within archery. As one participant, Sarah, noted: *"I suppose what I would have thought of as feeling natural when I started the course compared to now is completely different … Through coaching and practising and a bit more experience I've changed what I feel natural and comfortable is*." Sarah continued to explain that the posture she originally felt was 'natural' was just anything that "feels comfy" suggesting a kinaesthetic awareness which did not include the bow. That is to say, the natural posture was determined solely by the ease with which the body positioned itself relative to itself (situated within a space) rather than being optimised for the use of a bow. This often meant that archers would contort themselves out of position as they drew the string back, an action clearly unfamiliar to them. It also increased the chances of the string catching their face or arm once released.

[33] Yet the muscular, skeletal, and psychological changes brought about through learning such an embodied practice cannot be so readily relinquished.

Over time, and through practice, this begins to change. Archers learn to engage and strengthen their core to counteract the resistance of the string when drawing, a force which had previously pulled them inwards. They begin to locate their anchor points with more ease, therefore giving them a smoother draw, which requires less cognitive effort in the form of error-checking. They start to think beyond the shot, getting over the initial shock as the string snaps past their face, to ensure they complete the shot with a clean 'follow-through' which avoids altering the arrow's flight after the release. All of this makes the archer more skilled, but it also speeds up the shot sequence, reduces contact with the bow, and requires less concentration. In short, it reduces the extent of conscious engagement with the bow at a rate seemingly proportional to skill level thus allowing it to be deemed 'transparent'.

While the successful inclusion of the bow appears to demonstrate the suitability of the model of incorporation for mapping skill development in archery, it becomes perhaps even more clear when we turn our attention to reason an archer's skill may stagnate or decline across various time scales. Following Heideggerian philosophy of technology, those adopting models of incorporation emphasis three key reasons for the rejection of a technological artefact as were set out in *Being and Time* (1972). There are: conspicuousness – the moment in which a technology becomes apparent usually due to ceasing to function, obtrusiveness – the noticeable absence of a technology, and obstinance – where the technology itself impedes the performance of the task (ibid, see also Hayler, 2011). All three are present within archery and occur as the model would predict.

The simplest of the three is the bow becoming conspicuous. In Heidegger's language this primarily refers to the technology being physically damaged to the point it cannot be used for the original task. The (complete and irreparable) breakdown of a bow was unusual within the EUAC and was the cause for great anxiety. When a bow was showing signs of damage more experienced archers, and more advanced technologies, were brought in to inspect, measure, and assess the damage to determine whether the bow was safe to shoot. These inspections were predominantly visual as drawing a damaged bow could cause the limbs to snap, injuring anyone nearby. A quirk of the archer's approach to conspicuous technology was ensuring its complete destruction if it was deemed beyond repair. Warped limbs were snapped, broken arrows heavily wrapped in taped and collapsed bosses were marked. This came about due to the distinction between bows which were *ineffectively conspicuous* (i.e. they shot unreliably) which could be judged through use and experience, and those which were *dangerously conspicuous* (i.e. those which could break further and cause harm). This demonstrated the conspicuousness of a bow existed on a spectrum for archers, rather than being a discrete category. Continued use could cause a bow to become more damaged, and thus more conspicuous, whereas repairs could make it less so.

Alternatively bows could become obtrusive in use. This primarily occurred due to the actions of other archers who would carry out pranks by removing bits of equipment to see if their absence was noted. Various bits of paraphernalia and accessories, such as individual arrows or the grips used for removing arrows from targets, could be missing for entire sessions without the owner knowing. But direct changes to the bow drew attention much faster. Yet, occasionally, archers would not immediately realise something was wrong. As one archer reflected on a session in which a counterweight was removed from her bow noted:

> "So, take my barebow weight situation. So, when I didn't have a barebow weight [as it had been hidden] and I was pulling back, and I was holding it felt wrong because this arm… it wasn't like it wasn't heavy enough it just didn't feel right. But I couldn't tell you why. I knew why […] but it was just a feeling that it wasn't right." (Naomi, interview)

As Naomi's experience tells us, the technology can undergo transformations without users being fully aware of what these are, yet the fact a change has occurred is noticed. This might be taken as disrupting the notion of a technology becoming incorporated, bur even when our 'natural' bodies undergo change (such as an injury) we cannot always pinpoint what these are by the experience of the sensation alone. Instead, we often require visual or tactile confirmation. As would be expected under the model, when part of the bow is absent the quality of the archer's performance decreases and they describe a sense of 'wrongness'.

The final, and most prominent, reason for the bow to be rejected is obstinance. Within archery the most common form of obstinance is within the use of a bow-sight. Many archers choose to shoot 'barebow' meaning that shoot without any aiming device, of those a considerable portion reported that this was because they "couldn't work out how to use a sight" (Naomi, interview). Murray describes a prosthetic user struggling to adjust to "think[ing] left-hand[ed]" (2004: 969) as they had been born without a left hand and so the movement seemed alien to them. Archers described a similar sensation when it came to learning to use a sight. Some found the sight to feel "less natural" (Hannah, interview) or require them to position the bow uncomfortably (Alice, interview). But the most consistent reason was that the sight was too "fiddly" (Sarah, interview) and so rendered the bow "more like a machine-ish thing than a bow" (Laura, interview). In doing so the bow becomes obstinate. By becoming machine, it differentiates itself from the fleshy body. To understand this through cybernetics theory we could say that for a signal to flow between components of a system and convey information the components must be of the same kind or the signal must be appropriately transformed. In the skilled practice of archery, under the model of incorporation, both bow and body are 'of the same kind' once the bow has been incorporated as it is deemed an extension of the body.

However, this point of intersection is made vulnerable by as differences come into focus. When archers describe the bow as “machine-ish” what they are describing is its unfamiliarity, an alienism or alterity which prevents empathy and communication, and therefore incorporation. Yet, by becoming machine the bow also demonstrates its independence, it is a material being with a material power. Rather than thinking of these moments as indicating the failure of technology and skill we could conceive of them as moments where the technologies exert their independence and, in doing so, reveal the user’s dependence on them. With this in mind, I now move to a brief intermission in which I introduce new – and specifically vital – materialist theories. These theories emphasise the agency of objects and/or material processes and so would defy the idea that tool can become transparent with use. By bringing vital materialism into conversation with the model of incorporation, I set up a critique form which I can build an alternative, and livelier, model of skilled technology use in the last half of the chapter.

9.2 A Vital Materialist Critique

While the model of incorporation, as I have shown in my discussion thus far, be applied to the context of archery with some success, at times it falls short of accurately describing the technologized performances of the archers. Some behaviours of the archer do not fit into those that would be expected under the model, and these will be the focus of the latter half of this chapter. Here, however, I turn to new materialist thought to provide a foundational overview of the literature which will be used to support my alternative model.

As a school of philosophy, materialism dates back thousands of years. However, within Western thought the movement became more prominent around the Enlightenment era (e.g. Stewart, 1790) where it resisted the Cartesian dualism which distinguished mind from body. The abeyance of materialist writing towards the end of the twentieth century has been associated with the similarly timed “exhaustion” of the approaches widely used by materialist thinkers, such as existential phenomenology and structural Marxism (Coole and Frost, 2010). Due to its central tenant that matter was at the core of being, materialism was traditionally opposed by vitalist approaches (Garrett, 2013) which posed a dualistic view of living and non-living bodies. Yet historical approaches to materialism, such as those practiced by Hegel and Marx, tended to focus on large scale processes and social institutions (Fox and Alldred, 2018), by contrast new materialisms are a bottom-up approach which pays greater attention to the more mundane objects (ibid) and the consequences of their amalgamations (Bennett, 2010). Where materialism was closely tied to existential phenomenology

and structural Marxism, new materialism is closely aligned to relational (Coole and Frost, 2010) and posthumanist (Braidotti, 2013; Fox and Alldred, 2018) approaches. As a result, new materialisms can be aligned with postphenomenological methods and cybernetic thought. Furthermore, as Fox and Alldred (2018) observe of Dewsbury's (2003) work, new materialisms offer an impetus to a non- (or more-than-) representational methodology. They note that geographical works in this vein have adopted "affective engagement" or "witnessing" as a method (pg. 199). Some examples of this will be discussed later in the form of visceral methods.

Despite the clear roots in materialism, and its close association with various other schools of thought such as posthumanism, the 'true origin' of new materialism is widely disputed (Vosters, 2014). This is in part because the ideas it proposes are, while potentially radical, so pervasive. The possibility for active participation of objects in assemblages and events has been discussed are varying lengths by the likes of Latour (1993), Massumi, (2002), Serres (Serres with Latour, 1995), Sartre (1956), Merleau-Ponty (1948) and many others. Fox and Alldred (2018) explore numerous different, but overlapping, theorists whose work could be understood as new materialist – including the work of Deleuze and Guattari, Karen Barad, Rosi Braidotti, and Bruno Latour. However, in recent academic literature it is Jane Bennett's *Vibrant Matter: A Political Ecology of Things* which has pushed for greater attention to the role of things in our lives and which most influences my work. Bennett's work seeks to recognise "that the capacity of these [object's] bodies was not restricted to a passive "intractability" but also included the ability to make things happen, to produce effects." (2010: 4-5). The vibrancy in Bennett's 'vibrant matter' refers to the active, rather than merely *re*-active status of objects. Bennett, and other new materialists, use this stance to remove humans from their position at the ontological centre (ibid) thereby dismantling the distinctions between organisms and their environments, humans and nonhumans, life and nonlife – a set of distinction which pragmatist John Dewey had already suggested was merely "superficial."

The model of incorporation similarly challenges the notion of any solid and non-traversable boundary separating bodies, however in doing so it understands objects as being subsumed by human bodies. This maintains the position of humans at a "hierarchical apex" (Bennet, 2010: 11). Using the example of bones, Bennett dismisses individualistic perspectives which see the world as containing discrete, bounded entities. Her claim that "we are rather, *an array of bodies*, many different kinds of them in a nested set of microbiomes" (2010: 113, emphasis in original) is reminiscent of Mol's 'body multiple' (2002) yet also speaks to Ihde's multistability (1993). Barad also refers to this internal differentiation, through which the living and non-living comprise one another, as the "infinite alterity that lives in, around, and through us" (2012:9). Barad's work, which focused on electrons rather than bones, uses

a non-representational stance to rework and problematize the notion of boundaries (Warfield, 2016; Barad, 2003) particularly between things and their representations.

There have been several notable efforts, inside the academe and out, which demonstrate the very attitude towards objects that Bennett promotes. One remarkable example of this is the 'deodand'. Existing under English law for nearly nine-hundred years until abolished in 1846 (Pervukhin, 2005), the deodand[34] was an object held responsible for the death of a human, and thus taken by the crown and sold to remediate the damage it has caused (Bennett, 2004). Pietz cites the deodand as a natural result of the need for a culture to establish some way "to settle the debt created by unintended human deaths whose direct cause is not a morally accountable person, but a nonhuman material object" (1997: 97) and, despite the abolition of the law nearly one-hundred-and-seventy years ago this need still appears to remain. One form it takes is detailed by Scarry (1995) who observes that in descriptions of pain we often resort to attributing them to an external agent or thing. This 'thing' may be metaphorically present or, when there is a clear 'perpetrator', more literally so. More generally, we often resort to blaming objects for causing us injury through their (mis)placement or (mis)use despite, at times, the fault lying with the injured party. An example of this would be feeling a sense of anger towards a corner table on which you stubbed your toe. Yet, through her vital materialist approach, Bennett (2010) further widens our appreciation of the extent of the role that non-human objects play in our everyday lives. She achieves this through the example of the Northeast blackout of 2003, which affected over fifty million people in the United States and Canada. Bennett uses the blackout to articulate and exemplify the "intricate dance" between humanity and nonhumanity (2010: 31) pointing to the cascade of nonhuman and human factors which produced the phenomenon. The distributed nature of agency, Bennett claims, makes it both impossible and meaningless to ascribe responsibility (and therefore agency) to any particular individual or group of human or nonhuman entities. Instead the event occurred due to the complex interplay between a great number of factors, including historical, cultural, political, and environmental aspects.

New materialist thought becomes useful for this study precisely because it resists the urge for a human-centric understanding of human-technology relations. Geographical applications of materialist thought have led to much debate (see Anderson and Wylie, 2009, for example). More recently this debate has taken the form of visceral methodologies. In a special issue of Geoforum, Sexton et al. (2017), Ash (2017), Hayes-Conroy (2017), Sweet (2017), and Miele (2017) sought to delve into the role that bodies – including nonhuman bodies – play in research. The relevance of their work to this thesis

[34] From the Latin 'deo dandum' – 'to be given to god'.

is well illustrated by one extract from James Ash' work in the issue. In an exploration of a musical performance, Ash states:

> "I would argue that his bodily movement is not just a performance of movement for an audience, but a performance of movement for the guitar and the sounds the guitar produces. In other words, his bodily movement is not an addition 'on top' of the sound created. Instead much of his bodily movement is integral to the sound that is produced by the guitar." (pg. 206)

Within this brief quote, Ash identifies a relationship between guitar and guitarist which does not simply position the guitar as a subservient 'tool' used by its player, but rather sees the guitarist as a "conduit" through which the guitar can perform 'its' music (ibid). In doing so, Ash is alert to the idea that "underneath this docility [of the 'possessed' object] [lies] a surreptitious appropriation of the possessor by the possessed." (Sartre, 1956: 609). Such a claim is echoed in the geographical approach to postphenomenology through its effort to "[take] in the inhuman and nonhuman" by recognising action as being a "creative force distributed across bodies and worlds" (Lea, 2009b: 374). This "intricate dance" between humans and nonhumans (Bennett, 2010: 31) points to a cascade of intentions and imperatives, as discussed elsewhere in this thesis, which muddles perspectives that promote the primacy of a human subject – including that outlined in the model of incorporation. This is echoed in Karen Barad's call for "a robust account of the materialization of *all* bodies – 'human' and 'nonhuman'" (2007: 66).

These methodologies further distinguish themselves through a call to attend to "important questions around what it means, how experiences differ, and how it *feels* to be a particular body – researcher or researched – amongst other (non)human bodies" (Sexton et al, 2017: 200). In the world of archery, a world I have so far shown to be largely constituted of and controlled by nonhumans (e.g. the range, the shooting line, the target face, the whistle) the question of how these objects, and the various ways in which they might be distributed, alter the experience of the performance is key. Yet, in doing so, I leave open a key question which cannot be fully answered by this study – how does the bow (or other nonhuman actor), as a body, experience the performance? The model proposed in the later sections of this chapter does attempt to account for this, yet within this overview of new materialist thought I must examine what might resist my attempts to do so.

The question of an object's experience is precisely the kind of question Ian Bogost's *Alien Phenomenology* (2012) seeks to answer. Bogost uses Thomas Nagel's essay *What Is It Like To Be A Bat?* (1974) as starting point for a discussion on the dangers – and unavoidability – of anthropocentrism in efforts to describe the experiences of nonhuman others. Nagel laments that any attempt for him to understand it is like for a *bat* to be a bat is undermined by his humanity, at best he

could only ever grasp at what it would be like for a *human* to be a bat (ibid). Yet where Nagel seeks to overcome this through an "objective phenomenology" (ibid), Bogost's alien phenomenology recognises this endeavour as fruitless and instead "*welcomes* such distortion" as is brought about by our reliance on our "own internal properties" when making sense of others (2012: 66, emphasis in original). The result is an understanding formed of caricature, analogy, and metaphor. We can begin to grasp at the experiences of a bat through those of a submarine, Bogost argues, and while not wholly accurately this is at least a starting point. Yet this is problematic. We can only draw the comparison between a submarine and bat because we already understand some of the mechanics of a bat's experience – that is, that it 'sees' using sonar. But what of nonlife? Are technologies too 'alien' for even this approach? In part, no. If they were then the submarine/bat comparison would be of no use. The reason that we can empathise with the bat's experiencing of the world via sonar is precisely because *we can know* the submarine's experience, or at least a caricatured and metaphorical translation of it. Bogost further evidences this with an exploration of a camera's perspective (2012: 70), but of more interest to this thesis is the fact that archers demonstrate a cultivated, albeit potentially heavily anthropocentric and anthropomorphic, ability to recognise and respond to the experiences of their equipment. This suggests that Bogost's alien phenomenology is not a solely academic process. Rather, the ability to perform such an object-centric phenomenology, through which the user can appreciate the tool's experience of the world, may be a key component to skilful tool use. I now turn to explore this possibility using the empirical material gathered during my time with the UEAC.

9.3 Towards a Companion Model

A new materialist critique of the model of incorporation would view the assumption that technologies are, when used skilfully, "thought of as a part of the body" (Hayler, 2011: 52) as underestimating the agential capacity and the vitality of technologies themselves. Although I have demonstrated that an incorporation-based model can, with reasonably accuracy, be applied to the practice of archery this does not mean that it is either the ideal or only model. Within this section I propose an alternative. This model, which we might call a 'model of companionship' or a 'companion model', opens up spaces for the objects to present themselves, engage as actors, and carry out lives on what might be understood as 'their own terms'. Themes of communication and intimacy remain key, as does the blurring of boundaries. But it is the relationship between technology and user which is the locus of skill development, rather than skill being found in the body itself. In this sense the model is new

materialist, but also post-human, and finds its foundations in postphenomenological, cybernetic, and more-than-representational thought. Despite its myriad of theoretical and conceptual lineages, the model was developed through grounded research. By this I mean that the overlying structure of it emerged through the analysis of empirical material, through the practice and performance of participants.

Three main themes are explored within this section. I begin by identifying how archers ascribe personalities to their bows – or observe them within. Secondly, I look at how a sentimental relationship forms between the archer and their bows, and what the consequences of this might be. As has been discussed elsewhere, the affective dimension to archery is a prominent motif, especially within competitions, and so the sense of a personal connection with equipment should not be understated. I then look at the tendency for archers to name their bows. It is this point which most clearly distinguished the bow not only from the body but, for the most part, from the other pieces of equipment archers carry. Only one participant named their arrows; others claimed that they broke far too frequently for this to be worth it.[35] The process of naming is closely linked to the two previous points and represents the most significant 'Othering' of the bow. I argue that by providing a bow with a name the archer acknowledges its agency and vitality. Finally, I conclude by drawing these three points together to consider the consequences of such a model. Here I discuss how the experiences archers who develop relationships fitting this model (instead of an incorporation-based approach) might differ, particularly with reference to skill, as well as considering the possible application the model might have outside of archery.

When it comes to attributing personality to nonhuman, and non-living, objects archery is by no means unique. This is a practice carried out routinely in small and seemingly insignificant ways. Terms normally reserved for describing human personalities such as 'temperamental,' 'unreliable,' or 'trusty' are frequently applied to tools and technologies with little consideration for what we might really be implying (Reeves and Nass, 1996). Nor is this a new phenomenon; Heider and Simmel (1944) carried out a study on 'apparent behaviour' nearly eighty years ago from which they concluded that people were quick to perceive humanlike dispositions within objects. In particularly patterns in motion were thought to be, or understood as, demonstrating intent. More recent studies have looked at neural activity in an effort to further understood how our brains responded to such objects (Harris et al, 2005; Harris and Fiske, 2008). These studies concluded that there is a strong resemblance in neural activity between attributing dispositions to people and objects with the exception of the medial prefrontal

[35] A claim which itself suggests the suitability of this alternative model as the short lifespan of arrows appeared to deter archers from developing a sentimental relationship with them.

cortex (MPFC). The MPFC, the area of the brain closely associated with planning complex cognitive tasks and engaging in social behaviour, was not active when participants confronted objects. Harris and Fiske conclude that this suggests that people might "imagine categories of objects having trajectories or even intent […] without thinking about their minds as humanly complex." (2008: 221). Within archery, the dispositions attributed to bows tended to stem from the material compositions, and while the terminology used varied, some terms were consistent. Bows were frequently described as (un/)forgiving, a trait normally derived from their poundage. A bow with faster or strong limbs could exacerbate any flaws in an archer's technique, hence unforgiving. Alternatively, as one participant described their bow: "It is nice […] I feel like my bow is like, because it's quite low poundage it's quite forgiving and gentle." (Hannah, interview).

Anthropomorphising objects in such a way was been seen to re-prioritise the user's attention away from pragmatic and functional considerations by sensitising them to the dispositions instead (Chandler and Schwarz, 2010). This could be seen through archers' focus on the aesthetics of their bows which, with a few exceptions[36], had no impact on their shooting ability. One participant described their initial desire to get a pink bow but, once finding they would have to wait for it to be shipped over, settled on a red one. This, in turn, began to shape their perception of the bow's personality firstly through associations and secondly through gendering. The same participant explained: "the pink compound, I wanted to call [it] Aurora because it reminded me of Sleeping Beauty." These colour associations then helped archers determine whether the bow's personality was a good fit for their own, not only through the naming process which will be discussed later, but through the colour association. Hannah's red bow was seen to be "a strong, nice bow" because of its vibrant red colour and so merited a name which matched this trait (Hannah, interview). Other archers opted for colours which were less common so as distinguish their bows. Sometimes these efforts were focused on the practical side of making it easier to identify their bow amongst others, but reasons varied. I was told that, due to the production costs, certain colours and types of paint were only used on high-end bows. As such archers might choose to get their bow in those colours, rather than any of the basic options, in order to emphasis its quality and to act as a status symbol.

The gendering of bows was one of the first indicators that the model of incorporation might not be suited to the practice of archery. Within the UEAC there was a frequent disparity between the genders people identified with and those they assigned to their bows. I believe that this disparity suggests that the bow is conceived of as a separate entity and not an incorporated extension. For some archers, the

[36] In some competitions, certain colours (such as neon shades) and patterns (often camo) are banned. Additionally, bows may not have markings in some areas as it is deemed that these could be used to assist aiming.

style of a bow was closely tied to its personality and gender, with the more technologized bows being masculine: “I feel like all the recurve bows are quite manly bows. They’re just like… they’ve got a lot of stuff on them and they’re like a bit of a show-off bow. So they’re quite manly. […] Compound is definitely manly. That’s quite an aggressive bow.” (Naomi, interview). Yet for others colour associations were key. Red and dark blue bows were seen as male, whereas light blue, pink, white, and sometimes black were seen as female. Green proved trickier for people to identify, possibly due to it being one of the rarer colours. There was little correlation between the two naming structures. My bow (black, barebow) was at variably identified as female for being black or barebow, or male for being loud and “aggressive”, a disparity which one participant did note but could not explain.

Although the bow’s genders did not necessarily correlate with the archers’ genders, they were seen to match their personality. In this sense bows could be seen as an extension of the archer; however, this could just as easily be attributed to archers either choosing bows because of the match, or bows’ identities being (re-)negotiated through use. Prominent examples of this could be seen in well-tuned, highly maintained, and precisely configured bows belonging to archers seen to be “tinkerers” or engineering either in a literal sense (i.e. through degree choice) or in their approach to archery. In such cases the bow was seen to be as precise as the archer wielding it. But this relationship cannot be so readily simplified to the level of incorporation. As I now move on to show there are more complex affective dimensions which need to be consider – of particular importance is sentimentality.

The development of sentimental relationship positions the bow as an object with worth greater than would be indicated by its financial and practical value. While this does not alone does not contradict the model of incorporation, when considered alongside the other properties discussed within this section it does point to a more nuanced relationship. Here I consider three facets of the relationship between archer and bow which indicate sentimentality as a core feature. The first is the sensation that each archers’ own bow is unique and so is their relationship with it. Throughout my time with the UEAC this was demonstrated through people’s behaviour towards their own kit and towards the kit of others. The second theme the affective response to damage, or perceived damage, to equipment. At times archers responded to broken equipment through forms of ‘mourning’ ritual which saw the equipment properly disposed of, commemorated, and/or attended to. Finally, sentimentality takes the form of a sense of trust and understanding developed between the archer and the bow. This dimension of the relationship, developed over the time, can also be compromised creating a period of deskilling spanning a variable time length.

The first of these themes may could easily be confused with a sense of ownership, and indeed the two may be interwoven. But the sentimentality and uniqueness of this relationship appears, at times, to

extended beyond one of possession. Archers were seen to favour their own bows over others even when the alternative was higher quality. When Hannah said of her bow "mine is mine" she was referring not to her ownership of it but was rather alluding to a sense that this ownership differentiated her bow from others. For this reason, novice archers expressed a desire to purchase their own equipment. Not only was all but guaranteed to be of a higher quality, it also enabled them to start developing this sense of intimacy. Yet, even amongst novices using club-provided equipment this trend could be seen. These novices sought out the bows which they had previously used, and the most successful novices tended to show a preference for consistency in their bow of choice even when this meant sharing with a greater number of archers. With novices, exceptions were more common. For example, novices would change bow poundage more frequently as they advanced from the eighteen-pound bows they started with until they settled around the thirty-pound mark at which point increasing poundage provided diminishing returns. A common motif within this thesis has been archery's nickname as 'the art of repetition' and so the development of sentimentality and the desire for consistency is unsurprising, particularly when more skilled archers have the ability to make microscale adjustments to their equipment to tune it to their own bodies. Yet, when interviewed respondents often struggled to verbalise any justification for this sense of attachment. Rather than describing customisations and alterations, respondents fell back to the tautological "mine is mine".

However, in their responses to other questions respondents did allude to deeper reasons for this sense of attachment which stemmed beyond practical qualities. Of particularly importance was a sense of trust and reliability. Studies have found that when technologies are anthropomorphised users are more readily able to ascribe them with a sense of moral agency (Waytz et al., 2010), we can observe a similar phenomenon here with the perception of trustworthiness. One participant, Seto, described how since purchasing a new bow this trust had been gradually building up over time and when he had tried to shoot a different bow style – in this case a longbow – that trust had been notably absent, affecting his performance: "swapping from your own bow to a piece of club equipment – in my case when I swapped to longbow – there is definitely a change in the degree of trust you have in the piece of equipment." But trust remained impermanent even when equipment did not change. Hannah described how, following an accident in which she was injured by the bow, her trust in the equipment temporarily broke down:

> "I hit my arm quite badly one time as Company [a local club] I think. […] I took like the rest of the session out because I was scared to shoot because it was quite painful. And I noticed I wasn't shooting as I should be because I wasn't doing what- I wasn't drawing back properly because I was genuinely scared that it was going to hurt me" (emphasis added).

Hannah's experience demonstrates that trust in bows can be fragile but is intrinsically linked to performance. It was not the injury itself that caused her skill to deterioration, but the resultant breakdown in trust. This is important to recognise as each – injury and distrust – require its own coping mechanism[37] and so alter the re-skilling process. While the extent of this is beyond the plausible scope of this study it is an avenue for further investigation and an important factor in the argument for an alternative model for the skilled use of technology.

The final point indicating a sentimental relationship is the approach to confronting damaged and broken equipment. I have previously noted that when equipment is deemed to be damaged to the point of being unsafe the UEAC endeavoured to ensure it was rendered completely unusable. There were, however, a number of other practices through which pieces of broken equipment invoked substantial affective responses which might be considered unexpected. It was not surprising that archers found equipment being damaged an upsetting experience; many sets of limbs – the most commonly broken part of a bow – cost upwards of £200 and arrows, which bent or cracked regularly, cost anywhere from £5-£35. Given the significant financial investment and the fact that, as students, some UEAC members were not always in a position to replace equipment, a certain level of 'grief' would be anticipated. This surpassed expectations when equipment was 'memorialised'. A photograph album was created on the UEAC's social media entitled 'Broken Arrow Memorial.' Despite only one photograph ever having been uploaded to this album, it was indicative of a larger trend. Broken arrows were frequently photographed and became a spectacle for members. Some, including myself, kept the more spectacular damaged arrows. Yet, by comparison, when bows broke the attitude was entirely different. The range filled with an awkward silence, a drastic contrast to the excitement stirred up by a 'Robin Hooded' arrow. No crowds gathered, a few of the more experience members and closer friends would speak to the archer in hushed whispers to make sure they were physical and emotionally okay. These were moments of trauma, not amusement; moments of shock, not excitement; of remorse, not joy.

These points, when drawn together, show that archers developed sentimental relationships with their bows beyond those required for their use. These nuanced relationships called for different kinds of encounters, ones which treated bows as agents with a liveliness. Although archers frequently struggled to capture this relationship in words during the interviews, this itself suggests that it overflowed a pragmatic and logic driven attitude and into an affective one. The status of this relationship is partially responsible for the third theme, which I now move on to consider – naming. Naming represents the archer's recognition of the bow as being a distinct and lively entity capable of

[37] Although, in this case both were healed over time

its own independent intention and so contradicts an incorporation-based model in which the technology must fade from the user's awareness (for example, De Preester, 2011).

Under Ihde's form of postphenomenology anything fitting into a model of incorporation would be deemed as participating in an embodied relation (Ihde, 1993; Verbeek, 2005). Here I argue that bows instead have the ability to form alterity relations. For followers of Ihde's postphenomenology this would be at the opposite end of a spectrum. Where embodied relations depict the technology as a "quasi-self" alterity relations place it as a "quasi-other" (Ihde, 2002). Throughout my interviews the topic of naming frequently drew comparisons to relationships with cars. Several archers justified their decision to name bows by claiming that it was not unusual for cars to have names. Indeed, while individuals might name cars, larger vehicles such as ships have names as a common practice. They are also gendered. The control of these vessels would not be mapped as an embodied relation. It may be deemed such a complex act that each task would need to be mapped separately, and the overall vessel deemed more a system than a technology. Yet we can see it as an alterity relation. This position raises questions about the term 'prosthetic technology' which is often deployed to describe those technologies which are discussed as being incorporated. I argue that the term prosthetic is limited, not because it overstates the extent of incorporation as De Preester and Tsakiris (2009) argue and I addressed in chapter four, but because it strips the technology of agency. The term 'prosthesis' comes to English via Latin from the original Ancient Greek 'prósthesis' meaning 'addition' (see also Parry, 2017). Thus, prosthetics are neither independent agents nor a part of the original body. Instead they defined by their role in supplementing and extending something greater. A prosthetic must always be an addition *to* and thus would not just be identified by embodiment relations, but defined by them, leaving no room for the sentimental relationships I observed in archery. Thus, we may wish to use the term "companion technology" rather than "prosthetic technology" to emphasise the interactive partnership that I have observed.

A key distinction between incorporation and companionship is the extent to which the technology becomes transparent. For embodied relations it does so, slipping out of focus as the relation cements itself (Ihde, 2002; Verbeek, 2005) yet as a quasi-other, in an alterity relation the technology is the focus of attention itself (Hogan and Hornecker, 2011). Similar to my example of the bow, Hogan and Hornecker note that a feature of an alterity relation is trust (ibid). More generally, an alterity relation is one in which users act *on* the technology, rather than *through* it. However, I would make a further distinction within the context of archery. Excepting bow maintenance and tuning, where the relationship takes a different form and may accurately be described as such, I argue that archers do not act 'on' their bows. Rather, they act with them. The naming of a bow resembles not only the

naming of a larger technology, but the naming of a pet (Borkfelt, 2011). It is perhaps not a coincidence that Ihde choose the horse as an example of an alterity relation (1990).

The act of naming represents the complex affects at play in the relationship between archers and bows. It positions the bow as privileged, above all other pieces of equipment which go unnamed, and further cements the "mine is mine" philosophy archers took. Developing such a nuanced relationship with a technology discourages users to replace it (Chandler and Schwarz, 2010), and some design companies have sought to create products which specifically engender this sensation (Verbeek, 2005). The idea being owners will repair and maintain, rather than replacing, any faulty equipment. As such, it could be said that the relationship between archers and bows is not only philosophically materialist, but politically so. Although not intentionally, it created an inherent environmental dimension to the practice, one which resisted the attitude of a "throw-away culture."

The act of naming further suggested an intimacy between felt towards the bows as could be seen in the fact that some archers who named their bows did not share these names with other members of the club. Upon revealing the name she gave her bow, one participant claimed that it was the first time she had ever spoken the name out loud. The relationship between an archer and their bow is therefore a deeply personal one. Just as bows are rarely shared, names are not given for the benefit of others. They are, rather, a crystallisation of a specific set of avenues of communication which are conducive to a deepening relationship. Yet not all archers named their bow. Laura and Hannah each owned an unnamed bow, and both attributed the absence of a name with the absence of any real sense of relationship with it. For Laura, a name was something assumed to come in time, suggesting a need for sentimentality to take hold before naming appeared. For Hannah, who possessed two bows, the fact she did not feel the need to name one of them was assigned to its material composition. As a longbow, its simplicity framed it in a different light: "I've had it for over a year and I've not named it because I just look at it like a stick." This provides us with an additional dimension against which we can measure this relationship. For technologies to be seen as an 'other' than may require some material complexity. This is counter to the work of Harris and Fiske (2008) who demonstrated that 'intent' was attributed to simple shapes moving across a screen in a non-random way. We can take this to mean, perhaps unsurprisingly, that the requirements for such a relationship to form are dynamic and determined both by the technology and its users. With all of these features set out, I now move on to conclude the chapter and consider the overall implications of this relationship.

9.4 Conclusion

This chapter has sought to outline the potential for incorporation approaches to explain some aspects of the relationship between archers and equipment but only to a limited extent. Through the introduction of vital- and new materialist work I have pushed to consider the agency of technology is human-technology relationships. Through this I have established a companion model as an alternative to the incorporation model. A companion model is an alternative to an incorporation model in two senses. The first is that it acts as a different sensitising device, drawing our attention to new facets of the relationship as it unfolds. Secondly, it also may be the case that different individuals, technologies, or settings render a model based on incorporation inaccurate. The model I have been drawing together here is therefore not intended to replace the pre-established approaches, but rather to act in parallel with them. Previous studies have shown that anthropomorphising technologies can engender a sense of empathy (Waytz et al, 2010), increase emotional bonding (Kiseler and Goetz, 2002) including trust (Chandler and Schwartz, 2010), and reduce anxiety about interacting with it (Luczak et al., 2003) suggesting a theoretical basis for associating the 'Othering' of a technology with its skilled use. In doing so we establish a model more closely resembling an alterity relation than an embodied one (Ihde, 1993).

Alterity becomes a key word here, because although it is impossible to anticipate an objects' experience of the world with any reliable accuracy, as has been discussed, the archers' performances do not fully anthropomorphise the bow. While 'human' characteristics are attributed to the bow, these would be more accurately described as 'lifelike' than specifically human. Traits such as intent, reliability, and affective disposure are not confined to the realm of the human. More importantly, despite these traits being understood through humanlike metaphor, the archers provide room for bows to express them in a specifically bow-like way. The bow is permitted space to create its own language: 'spoken' (rattling, creaking, thudding) and a 'body language' (shaking, swinging, wounding). The archer's true skill may well lie in their affinity to 'speak' this language and respond accordingly. It becomes, then, not a matter of subsuming the bow into the body of the archer but extending the archer's linguistic capabilities into the realm of the bow. When Clark claimed that "there is no merger so intimate as that which is barely noticed" (2003: 29) he privileged embodied relations. However, the relationship itself can remain subconscious and unnoticed without the technology becoming so. Indeed, archers frequently described moments in which thinking too much about the process caused them to hesitate and invariably blunder. Pragmatically, this model could be implemented in a 'research and development' role as Ihde encourages philosophers to do (1999). By acknowledging alternative forms of skilled use, and the facets of a technology they each privilege, designers can tailor

their focus accordingly. Verbeek (2005) provides an example of where one Dutch design company, Eternally Yours, has taken this stance. Their products are created with the intention of being noticed and therefore being more than simple mass-produced devices (ibid). Although a position paper commissioned by the Netherlands Design Institute noted that companies are not inclined to reduce their product turnover by encouraging clients to not replace products (Van Hinte, 1997) the case study of bows sees this issue somewhat alleviated through the sale of accessories (which can cost more than the base-pieces of the bow itself) and maintenance products. This means that the archery economy shifts from one solely about production to one that also attends to issues of care and performance. It would also, as I noted in section 9.3, reconfigure the position of so-called 'prosthetic technologies' as 'companion technologies.' The implications for this would need further exploration but could include significant changes to the design process of technological artifacts.

Finally, this model can provide insight for academics studying tool-use, technology and skilled use, and prosthetics. It has wide-ranging implications that could include anything from product design and training to the rehabilitation process of individuals with artificial limbs[38]. It provides a framework for understanding technology use through a postphenomenological and new materialist lens, one which does not privilege the role of humans. This prevents the technologies themselves being condensed into their 'mere' material properties. Overall, it is a model which attempts to shift the emphasis in 'human-technology relations' away from the 'human' and onto the 'relations.'

[38] The biomedical applications of this model are a prominent area for future research and are discussed in more detail in the conclusion.

10. Conclusion

This chapter serves as a point of reflection for the thesis. I begin by returning to the aims that I outlined at the beginning of the thesis and identifying the outputs responding to each one. These four subsections point to the thesis' key contributions to the literature show how they may develop the broader discussions taking place there. I then move on to review geography's relationship with cybernetics. The two have been used in close combination here, to such an extent that they cannot be easily divided. Through this section I reflect on whether geography is well suited to continuing cybernetics' legacy of speaking across disciplines. The third section reflects on the research outputs, including my interactive poster series, wellbeing resources and workshop material. While this section is non-exhaustive, it does provide an overview of some of the most innovative applications of my research. It also serves to demonstrate the wide range of topics to which the skilled use of technology is pertinent. Finally, I conclude the thesis by reflecting on three projects that could be used to carry this research forward in future roles. While some of these appear to build specifically on the contents of one of the empirical chapters, each is intended to be a continuation of the themes of the entire thesis.

10.1 Returning to the Aims

At the outset of this thesis I identified three prompts for this work to respond to: the need for a language through which we can discuss out relationship to the technologies which increasingly surround, encapsulate, and inhabit us; ESRC's call for research into how technology shapes behaviour; and Ihde's call for philosophers to enter 'R&D' roles. To respond to these prompts, I further identified four aims, outlined in the introduction, which sought to question aspects of our experiences of more-than-human practices through the lens of archery. A combination of interviews and ethnography were used to build up the established literature, which was drawn from a range of fields. Here I return to those aims to summarise my findings and note how this work has gone some way in answering crucial questions. I also use this as an opportunity to reflect on how these findings indicate potentially rich areas for future research and have raised more questions which were beyond the scope of this project.

Aim One

'to understand the processes by which the body is transformed to work alongside a prosthetic element in an assemblage or system with different (spatial) capacities

Through this first aim I set out to explore how the use of a prosthetic tool led to changes in our understanding of the body's limits. Ultimately, however, my observations led me to dispute the term 'prosthetic' and renegotiate the way we conceptualised the skilled use of tools. Nonetheless, my work continued to speak to the limits of the body, albeit perhaps a different kind of limit – for, as Abrahamsson and Simpson (2011) note, there are many. The limits I considered were communicative, and it is in these more-than-human communicative channels that I situated skill. This results in a distributed skilled system, one in which "spatial colocation" (Hollan et al., 2000: 175)) was not a requirement for interaction. The ideas generated in response to this aim also speak broadly to discussions of skill and more-than-human experience, with particular effort to continue to provide space for the nonhuman and inhuman to present themselves.

Disputing incorporation

Through a review of contemporary debates on skill and the limits to the body, I highlighted a series of trends to how human-technology relations are depicted in the broader academic literature. I refer to these approaches as being incorporation-based or as subscribing to a model of incorporation due to their shared depiction of technologies becoming transparent and being drawn into the body schema during skilled use. Notions of incorporation have a rich history in phenomenological work and they are exemplified through many prominent historical examples of embodied technologies, including Merleau-Ponty's discussions of the blind man's cane (1962) and Head and Holme's feather in a woman's hat (1911). These approaches are often associated with Heidegger's (1954) influential work on the withdrawal of tools during skilled use which has been shaped a lot of more recent work, including that of Merleau-Ponty and Ihde. However, while Heidegger doubtless advanced the field, incorporation-based approaches predate his work. In fact, there is no clear origin to such approaches, which, combined with their prevalence across a wide range of fields, suggests that there might not be a *singular* origin but rather it has emerged from a broader humanistic perspective on tool-use. The depiction of tools as extensions of the body is well captured by their description as 'prosthetic technologies'. As I discussed in Chapter Nine, the word prosthesis comes – largely unchanged – from

ancient Greek where it meant 'in addition'. As such, I have argued that incorporation-based approaches provide inherently instrumental and lifeless interpretation of technology and thus promote a perspective which emphasises human primacy. For this reason, I suggest the term 'companion technology' be used instead.

I have also noted that I am not the first to critique the use of prosthetic/incorporation terminology to describe tool-use. De Preester and Tsakiris (2009) also reject the terminology, albeit for different reasons. They argue that the terms should be restricted to discussions of artificial limbs – something many disability scholars support (see Sweet, 2016) – as they believe that incorporation requires a technology to become transparent and alter the body schema. While the former is possible, they argue that the latter is not and that the body schema can only be repaired – such as through an artificial limb replacing a lost limb – but cannot be extended to include, for example, an additional limb. There is some empirical evidence to support this claim; Murray's work with artificial limb users has highlighted that individuals born without a limb encounter additional difficulties when learning to use a prosthetic. However, this can be explained in a number of ways and does not preclude an extended body schema. Furthermore, De Preester and Tsakiris' argument that an altered body schema is a requirement is not entirely convincing. Hirose (2002) suggests that ecological approaches to skill do not require internal representations and so changes to the body schema would not be necessary. However, the greatest divergence between my critiques of incorporation and those of De Preester and Tsakiris' is the extent to which they distinguish between tools and artificial limbs. While I point to the limits of incorporation, I believe that these are applicable in any instance. However, my criticism of incorporation is not total. Incorporation based approaches do have value for studying certain aspects of a relationship – particularly the feelings of non-mediation – and I have demonstrated their (limited) applicability to archery. Rather than seeking to entirely discredit the approach, I used this critique to highlight the need for another approach which specifically values those areas ignored by incorporation-based approaches, notably object agency.

Adopting Companionship Approaches

Despite being a key part of phenomenology's history, incorporation-based approaches are outdated in light of post-phenomenological geographies' move to further recognise material agency. Through a vibrant materialist (Bennett, 2010) lens, I analysed the relationship between archers and their equipment to propose an alternative approach to conceiving human-technology relations in the skilled use of tools. This model, which I describe as a 'companionship' approach in recognition of the more equal distribution of agency between human and technology, seeks to further appreciate the role of the tool as an *active* participant rather than a subsumed 'addition'. Unlike incorporation approaches, which obscure difference by rendering the tool transparent, companionship approaches recognise

and appreciate difference by being attentive to idiosyncratic methods of communication. Thus, tool-users must be alert to the communicative efforts of their tools, which may be audible (e.g. rattling, creaking, clanging, as well as variation in pitch and tempo) or tactile (e.g. vibrating, wounding, shifting centre of gravity)[39]. These need not be translated or ascribed human equivalents but should be appreciate as forms of nonhuman-human communication as part of a more-than-human system.

Where transparency was the mark of skill in an incorporation model, trust plays a central role for companionship approaches. In both cases sudden, unexpected interference can be detrimental to the skilled practice, but in a companionship approach the user should seek to interpret and understand this as nonhuman communication rather than seek to eliminate it. This distinction is exemplified by the tuning process described in chapter eight, which is discussed further as part of aim two. Trust is enabled by familiarity and attentiveness but is no less prone to disruption than when interpreted through incorporation approaches, as has been demonstrated through the accounts of archers who struggled to trust their equipment after being injured. However, by accepting that such incidents do not represent a failure – either on the part of the archer or the equipment – but a lack of calibration it becomes possible to consider a new range of remedial solutions. Although it was untested within this thesis, this may suggest that equipment that would become unusable in practices best described by incorporation approaches may remain usable under companionship approaches, albeit after a period of re-attuning.

Within Ihde's postphenomenology incorporation approaches are clearly represented by embodied relations (Ihde, 1993). In such relations the technology is considered 'quasi-self' and the user acts 'through' it, as is made possible by its transparency. Tools are a common example of embodied relations, and Ihde uses an axe as an example (Ihde, 2012). On the other end of the spectrum are alterity relations. Here the technology becomes 'quasi-other'. When 'othered', technologies are *acted on*, but this presents an antagonistic relationship rather than a collaborative one. Instead, I propose that in a companionship approach one works *with* the tool. The table below (Figure 19) identifies further differences between incorporation and companionship approaches; however it is important to recognise that these approaches are not entirely polar opposites. As I have already stated, each is open to disruption through the same kinds of experience.

[39] In other human-technology relations this may expand to include other senses and other methods or communicating with these senses. For example, a winemaker may emphasise taste and smell over touch and hearing.

Incorporation	Embodied	'act through'	Similarity	Control	Instrumental	Transparency
Companionship	Alterity	'act with'	Difference	Communication	Affective	Trust

Figure 19 Incorporation vs Companionship

Locating skill in communication

Companionship approaches rely on increased communication with, rather than through, the tool. This has led to a reconceived location of skill, as is illustrated in Figure 20. Contemporary ecological approaches to skill locate it as being distributed across the entire system which is in-line with post-phenomenological approaches to more beyond a humanistic focus to discussion of experience (Lea, 2009b). However, where this approach locates skill as distributed, I argue that skill *is distribution.* That is, skill is not something held by an individual or a collective, but the patterning to the collective and the communication between individual parts. This diagram shows three approaches to locating skill (represented in red). The first diagram shows the classic approach of 'mastery' whereby the actor possesses the skill, a common assumption in studies of prosthetic limbs. The second shows an ecological model, now widely accepted in geography, which distributes skill across all participants. The final diagram shows my communicative model which shows the same arrangement as the ecological approach but locates skill in the network rather than the nodes.

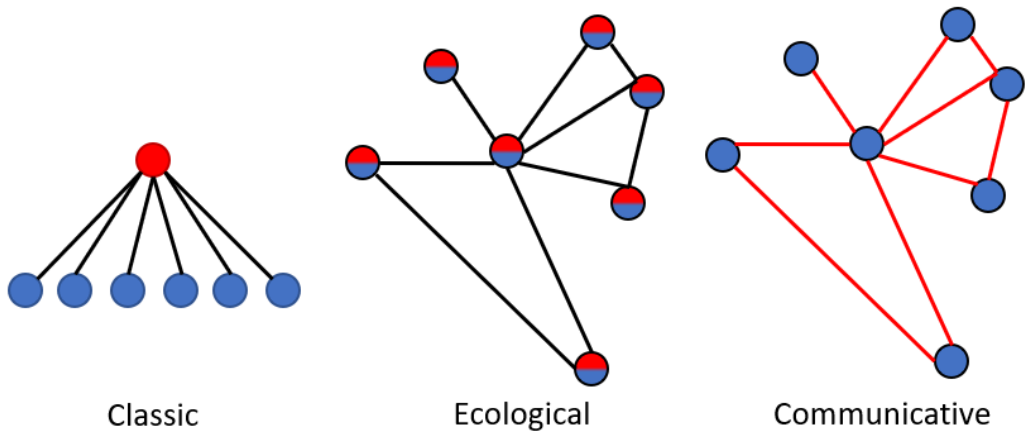


Figure 20 Skill theory maps

This allows for de-skilling to be understood as disruption to the communication using cybernetic notions of noise, which will be discussed shortly. It also means that de-skilling need not occur due to

failure but can be caused by a lack of or loss of familiarity (e.g. extended periods without practice or a change in equipment), environmental changes, interference, and incompatibility. The latter is demonstrated through the rejection of the sight by novice archers during the beginners' course. While there was nothing inherently wrong with the sight – nor with the archer – their approaches to communication were incompatible – or at least inefficiently compatible, meaning that it would overall be detrimental to performance. Furthermore, the focus on communication provides novel ways of thinking about – and designing – training methods. As I have shown, archery has a strong focus on developing personalised approaches. This is enabled through a series of loosely defined rules, prompts, and parameters within which archers can experiment (see also Lea, 2009a).

By locating skill in communication and by rejecting the assertions of incorporation approaches, I found that the transformation that take place to allow tool and tool-user to work together are not as pronounced as they might otherwise be. Rather than necessitating significant changes in the body schema (e.g. per De Preester and Tsakiris, 2009) or defining boundaries to the body (after Abrahamsson and Simpson, 2011), the changes take the form of the generation of new communicative pathways through which components of the system may better understand, predict, and communicate with one another. While such pathways do speak to debates around body boundaries, they do so by building on already established debates around the ecology of skill. Thus, this finding fits with other work in geography and cognate disciplines and provides new opportunities to explore skill and new (or renewed) languages to speak of them through in the form of cybernetics.

Aim Two

'*to explore the intimate and potentially productive geographies of (cybernetic) noise'*

In responding to the first aim I argued that skill was communicative, this raises questions of what happens when the communication is impeded or interrupted in some way. Cybernetics provided an opportunity to discuss this through the concept of noise. But noise is a broad term, both in the sense that what *constitutes noise* and what *noise constitutes.* Falling into the former group are a wide range of somatic sensations and affective dispositions, some of which have been the focus of other studies, as well as material imperatives. In addition, there were factors which did cannot neatly fit into any one category, or effortlessly bridge several. Pain and anxiety, hunger and tiredness, blustering winds and scorching heat, a loose screw and a torn fletching. All of these can be noise, but the greater

question, perhaps, is what 'being noisy' means. I attempted to answer this through three moments in archery: distraction training, tuning, and target panic. There are vast differences between the three, and so each showed noise in a different light and from a different angle. However, across the three I identified three different narratives for noise.

Noise as destructive

Within cybernetics, noise is often depicted as something we seek to exclude from communication (see Serres, 1982). Noise overwhelms and corrupts communicative messages. While, in chapter 8, I argued for interpretations that see noise in a more neutral light, there is no doubt that the destructive capacity of noise is prominent in studies of the skilled use of technology. Due to its emphasis on a perceived lack of mediation, discussions of noise are prominent in studies which adopt incorporation-based approaches. However, prior to this intervention, these debates have lacked an appropriate language to describe and explain the processes by which 'prosthetic' technologies may be rejected and how de-skilling occurs. Heideggerian phenomenology of tool-use provides three terms for describing how tools may fail to be incorporated – conspicuousness, obtrusiveness, and obstinance – which are widely use but far from ubiquitous. A crucial limitation is that each of Heidegger's reasons for failure is a variation on the technology becoming non-transparent, thus each places fault with the technology.

Social science explorations of de-skilling recognise that there are affective causes for the decreased performance and Heidegger's concepts of (un/)readiness-to-hand are insufficient to explain this. Noise, however, is not. I explore experiences of pain (Green, 2011; Spencer, 2009; Scarry, 1995) and panic (Bissell, 2012; Prior and Coates, 2020; Bawden and Maynard, 2001) to provide an account of how noise can provide an overarching narrative to explain a wide variety of de-skilling processes. By locating the disruption within communicative pathways between interacting components of a system, this application of noise requires that skill also be distributed. I identified that noise can occur due to external disruptions where new factors are introduced, or from internal disruptions. For archers, the former could encapsulate a variety of environmental conditions including the weather or the actions of other archers; the latter can take the form of target panic, a panic-like sensation of being overwhelmed which I identified as a sports specific instantiation of the yips (Prior and Coates, 2020). There are also disruptions that can fall into either category such as injury or damage to equipment. As previously noted, these forms of noise disrupt communication between the interacting parts of a skilled system and so diminish the overall performance.

A significant contribution here is that the concept of noise provides a neutral language to describe interference which is detrimental to skilled performance. It does not allocate blame to the technology, as Heidegger's work does, nor does it take the humanistic stance that much work on pain in social sciences has (e.g. Scarry, 1995). Noise is inherently more-than-human and so compliment more-than-human approaches to mapping skill. This provides opportunity to reconsider how processes such as the yips occur, and frame them as communicative discrepancies rather than failings.

Noise as constructive

The concept of noise also provides the opportunity to view undesirable interruption as having provocative and positive potential. I explored this through the concept of distraction training, through which archers were exposed to brief, controlled encounters with noise to develop "nested redundancies" (Sternad, 2018) allowing them to continue to perform optimally in sub-optimal conditions. Distraction training provided a constructive application for noise by aiding archers in generating new responses to changing environments. If we are to define skill as the extent of a system's ability to communicate across itself, then distraction training could be seen as establishing resilience and developing skill by generating redundant communicative pathways.

The presence of noise was also essential for archers to improve their performance through tuning. Noise, here, indicated inefficiencies in the system – such as equipment being mistuned. Importantly, it was neither the source nor the presence of these inefficiencies, but rather a consequence of their presence. This noise could then be interpreted to identify the flaw and rectify it. The ability to interpret skill in such a way was a skill in its own right and provided another example of archers learning to 'speak' (or, perhaps more accurately in this case, 'read') the language of their equipment. Not only was noise usable here, but it was also actively sought out. Archers removed stabilising equipment on their arrows (fletching) to exacerbate the presence of noise to make its presence clearer. I used Taylor's (2010) term of 'visceral insulation' to describe how this stabilising equipment protected archers from the "rawness" of the interference. I also draw on Ihde's (1993) claim that all processes of magnification create equal processes of demagnification to argue that stabilisation reduced the amount of information produced by the system and that, depending on the intention at the time (e.g. scoring vs tuning) either of these may be prioritised.

The notion of noise providing new information is not novel. Bateson (1972) described noise as being the only new source of information, a position taken by many cyberneticists. Outside of archery, noise is used to identify issues with a system such as through 'debugging' in computer science. The applications I observed in archery constituted a form of corporeal debugging. This suggests that there

is unexplored potential to use noisy disruptions to test and improve skilled systems across a variety of practices where debugging is not conventionally practiced. Following my observations, I drew on the principles of distraction training and replicated them in the form of targets designed to help those suffering from the yips. Although these targets were not tested as part of this project, they exemplify the possibilities for further research in the area and provide a practical demonstration of how noise can be designed into technologies. These targets use noise in several ways. Some recreate the experiences of target panic in milder forms to provide an opportunity for archers to confront the experience, while others distort the target to remove the 'triggers' that can cause target panic to set in.

Noise as revelatory and transformative

In combination, these two interpretations point to a neutrality of noise. While this thesis has explored both constructive and destructive instantiations of noise, in doing so it has argued that noise is not inherently either. Rather, noise is a term applied retroactively to describe unanticipated and unintended intrusions into a communicating system. Noise, therefore, is inherently revelatory and transformative. It reveals limits, boundaries, and weakness and causes the system to mutate in its presence. This suggests that further research could use noise as an avenue to explore body boundaries. Both Scarry (1995) and Green (2011) have attempted this through explorations of pain. In both cases, I have noted that both conclude that experiences of pain draw attention inwards to the corporeal body, shutting out the world. However, their studies did not consider how this may factor into, for example, the rejection of artificial limbs.

The language of noise and communication provides an opportunity to discuss skill and de-skilling in a way that is open to vibrant materiality and does not privilege human agency. As well as the discussions of pain, anxiety, and distraction that have been attended to so far, these concepts speak to debates around how objects experience their position in more-than-human systems, an area thus far underdeveloped. Many instances of noise can be interpreted as in/nonhuman expression. I have shown that noise is largely disrupted when it is unexpected and misunderstood. The concept of noise-as-communication is a provocation for future studies to better understand how we can understand the nonhumans we work alongside. Given how valuable the intimacy between archers and bows provided in conducting this research, this is an area that may be best explored through practice-based approaches and made provide particularly rich findings for studies of arts practice where the agency of the medium is already established in the literature.

Aim Three

'to understand the movement from hesitant bodies to skilled actors, with particular reference to how agency and affect(ivity) operate within more-than-human systems'

While the previous aims focused on the underlying structure of a skilled system – considering issues like ecologies, communication, and interference – this aim turned to consider how the framework for a skilled system is constructed. It sought to locate the agency of skill formation and recognised that skill does not emerge independently. The Dreyfus brothers once remarked that there were two ways to develop skills: to seek instruction, whether from a person or a guide, or to attempt to learn "like a baby, … by imitation and floundering trial-and-error" (Dreyfus and Dreyfus, 1980: 1). Despite their criticism, in responding to this aim I found that archers resorted to a combined approach. Instructors and guides provided structure and purpose, but ultimately technique was determined through the very trial-and-error approaches that Dreyfus and Dreyfus disparaged, floundering, often, included. This is more in line with experiences described by Lea (2009) and Krzywoszynska (2015) which present skill as a more organic, less linear occurrence. In responding to this aim I explored how both people and environments shaped and scaffolding the learning process.

Scaffolded learning

In attending to this aim I explored how gesture and the physical manipulation of archers' bodies by instructors were part of a distributed teaching structure. Gestures were used to explicate hard-to-verbalise body movements in a way that simultaneously allowed instructors more precision and less specificity. This was a crucial part of an 'experimental' training praxis (see Lea, 2009a), whereby archers had freedom to find a preferred technique within established parameters. Gestures provided a form of communication that conveyed how a body should be positioned *relative to itself* rather than an idealised 'normal' body. In practice, this meant that the exact position of the body varied from one archer to another which was reflected by participants' claims that there was no "correct" technique for archers, albeit they acknowledge that there were plenty of wrong ones. 'Mirroring' was a prominent example of gestures being used in training and was often deployed as a substitute for an individual's own proprioceptive capacity. Instructors would mirror a novice archer's actions back at them in an exaggerated "pantomime" (Downey, 2005) to draw attention to mistakes. Per Downey (2010), these non-verbal forms of communication were more universal than traditional instructive

approaches as they did not require any technical knowledge on the novice's behalf. This, coupled with the variability of technique open archery up to a range of bodies and levels of mobility, arguably making it a disability-friendly sport which may provide opportunities for further research from disability scholars.

Instructors resorted to physically manipulating the bodies of the students when even non-verbal cues were ineffective. This was most common when focusing on the position of the back and drawing arm as archers were unable to see what they are doing while at full draw and clothing would obscure mirrored movements. By forcing bodies to contort in specific ways, instructors created a situation in which the novice archers had to return to a position – within reasonable variation – rather than identify it. Physical manipulation was used to a limited extent for a range of reasons including the possibility that attempts to rectify one issue would create others by forcing the archer out of position, respect of personal space, and risks with proximity to the equipment. Both gesturing and physical manipulation fit in expanded interpretations of wideware (Alač, 2005) or scaffolding (Downey, 2005) and point to the importance of more-than-representational approaches to teaching. Previous work has disputed claims that practitioners cannot speak about their practices (Hitchings, 2012), and these findings speak to this debate. Non-verbal forms of communication were not poor substitutes for verbal communication, but specialised tools which held an important place in the practice. As such, they lend credence to arguments that practices are more-than-representational, with a variety of forms of communication playing important roles. In making this argument I also identified that the instructor was an active part of the skilled system, and not an external mediator. Instructors took on some of the effort of the practice to reduce the difficulty for learners, and in doing so were part of the ecology of skill. Over time, the instructors stepped back and allowed the novices to take a greater share of the responsibility. However, their original presence suggests that skilled systems can extend beyond individual people augmented by technologies to include an array of people and things.

Building on this, I further explored the role of the range in the learning process of archery. I noted its role as an active participant in framing how archery is performed, and that these tasks are conducted in lieu of a human actor. This follows work carried out in ANT and postphenomenology (Rosenberger, 2014). I observed how instructors used equipment to prompt their own memories which further indicated that skill did not lie within the individual but emerged out of the relationship between archer, equipment, and environment. I also discussed how the range markings, notably the shooting line, worked with the whistle signals to enact the temporality and spatiality of the range. Within this work I only briefly touched upon this as a framework to enable the training process, but further work could draw on Massumi's description of the football field to further explore how the range re- and de-potentializes the actions of archers. By recognising the value of the work done by the range I opened

possibilities to consider how its influence is experienced through atmospheres, something I turn to now.

Attuning to atmospheres

Through the concept of affective atmospheres, I argued that the range is not simply a space – physical and affective – to navigate, but an active part of the practice of archery, and that archers must learn to attune themselves to it. The practice of attuning to atmospheric changes has been discussed by Merchant (2012) and Allen-Collinson and Hockey (2011) in the context of scuba divers continuously adjusting equipment in response to minor changes in the environment. As for Merchant, here this process of attuning represented an intimate familiarity with environment and its perturbations. This familiarity was something normally developed over time, and so immersion in a variety of conditions was an important part of training. Because of archery's repetitive nature, archers quickly adapted to the most common settings but had limited experience to distract differentiations. Distraction training, as previously discussed, was a core part of remediating this. But exposure to a variety of competition formats and weather conditions was also crucial. These efforts were not to remove the disruption, which would not always be possible, but to make it "matter less" (Sternad et al., 2014; Sternad, 2018).

Attunement, as practiced by the archers, had a limited role. Archers only actively emphasised these processes with regard to changes in environment, most notable weather conditions and competition pressure. However, I identified that attuning to the atmospheres of the range could help those experiencing target panic or, more broadly, yips. This suggests that attuning to atmospheres is a potentially rich area for further research that explores wellbeing and affective disposition, particularly in sporting practices. Links between attuning and mindfulness could usefully feed into debates in both mindfulness studies and sports practices. Mindful training methods could be used to help sports performers overcome issues like the yips, suggesting that there is room for meaningful collaboration between the fields. Associations between mindfulness and skilled practices, most notably art, are widely established and previous studies have commented on martial arts practitioners using the competitive sport as a form of mindful distraction (Green, 2011).

Aim Four

to situate the specific spaces and practices of archery within the broader literature of geographies of embodiment, performance and practice

The final aim sought to situate the work of the thesis in broader conversations about bodies and performances. This was achieved both through empirical work and through discussions in the literature review. Some of the areas highlighted here are only lightly touched upon within my analysis and are noted as areas for future research to consider in greater depth. The work has responded to, built upon, and, at times, called into question the work emerging in post-phenomenology through its interests in experience and the ephemeral. It has also spoken to literature on embodiment, largely through the context of skill and so much of this has been discussed under the other aims. However, here I reflect a little further on questions and possibilities raised for geographers working on embodiment. Finally, I note how the work responds to three of Ingold's (2018) "questions of skill." These are not definitive answers, but developments in the conversation that could guide future work.

Post-phenomenological geographies

Geography's foray into post-phenomenology has gained a better-defined identity since Lea's (2009b) first overview (Lea, 2020), although it still lacks cohesiveness of its counterpart in the philosophy of technology. Throughout this thesis I have drawn on both post-phenomenology and postphenomenology and, while I believe there are important contributions to each found within this work, here I primarily focus on the former. That is not to say, however, there are no points where the two have potential to overlap as they have done so here. Kullman's work on 'design geographies' is one of rare instances where Ihde's work is prominent in geography (see for example Kullamn, 2016). I have highlighted at various points how reconsidering the way we form skilled relationships with technology can inform the ways we design those technologies; debates within design geographies could further explore the potential to reshape the design process to place philosophers (and geographers) at the forefront of "R&D roles" (Ihde, 1999). However, at this stage it is important to recognise there are discrepancies between the two approaches. And while I have sought to resolve this, I did so within the limited scope of this project. Further work on the area would need to focus further on resolving these ontological debates and reviewing which conceptual tools could productively be ported from one post(-)phenomenology to the other.

Underpinning this is another substantial area of this research: material agency in skilled performance. Following Lea's (2009) assertion that post-phenomenological approaches to geography seek to extend experience beyond the human, this work attended to discussions of vibrant materiality (Bennett, 2009) to present the nonhuman actors in archery – namely the range and the bow – as being active participants in the practice. The steps away from the position of viewing as technologies being mere

mediators, a role even contemporary studies in philosophy of technology place them in despite effort to acknowledge their lack of neutrality (e.g. Verbeek, 2005). When Michael (2000) spoke of technologies as not being "faithful messengers" (pg. 121), he aptly encapsulated traditional depictions of tools-in-use. These approaches, many of which I have discussed in the context of incorporation (including Heidegger, 1954; Hayler, 2015), understand the any divergence a technology makes from its user's intention as being a flaw. Here, it is instead understood as being part of the technology's attempt to assert itself and communicate in its own way. Recognising the limits of human's ability to understand the perspective of nonhumans, as presented by Nagel (1974) and Bogost (2012), I have focused on communication with knowing being a pre-requisite. In many senses this reflects Ingold's difference between specification and articulation. For Ingold, explication consists of two stages: pinning things down to "fixed referential coordinates" (specification) and "connect[ing] them up" (articulation) (2018:160). The communication between humans and nonhumans described in this thesis is articulatable, but never seeks to pin the object to a fixed identity, for this would always necessarily be anthropomorphised. This provides opportunities to further explore performance as a more-than-human collaborative effort. There is particularly rich potential to for exploration in practices which involve intimate relationships between humans and nonhumans, as in archery, which may include driving, blacksmithing, or music. There is also the possibility to expand the interpretation to include animal nonhumans by looking to performances such as horse riding.

In considering the agency of the range, this work has highlighted the importance of grounding studies of skill in particular environments. We cannot assume skilled performance will persist through significant changes to the environment, as has archers have recognised through approaches such as distraction training. This raises significant challenges that are yet to be explored about how well skills can be relocated. These challenges have been acknowledged in the context of extreme and hostile environments, such as the Antarctic (White, 1989) and space (Kubis et al, 1972), however my findings suggest that there is a need to account for much smaller changes than these.

Feeling bodies

Through its exploration of pain and anxiety this work has spoken to debates on emotion and embodiment. I have highlighted how experiences of undesired somatic sensations can be detrimental to skilled performance but have also challenged the assumption that they are necessarily so. This follows the work of Green (2011) whose participants noted that the pain they felt during their participation in Mixed Martial Arts training was produced an "inwards movement that cuts through preoccupation leading to … a discovery of the 'self'" (pg. 391). I have explored how this 'inwards

movement' can draw attention away from essential components of the practice, such as the bow, and thus be detrimental, or can work to 'cancel out' the impact of other distractions and allow greater focus on archery. This provides a more neutral framing of pain and other undesirable sensations which provides space to nuance our accounts, opening up further possibility to consider how, for example, experiences of pain can be essential to identity formation, such as for Sobchack (2010) and Bissell (2009). Through the concept of noise, these sensations become disruptive but also information. This runs contrary to the work of Scarry (1995), for whom pain destroys and defies language. Yet, here, it becomes language.

Questions of skill

At the close of Cultural Geography's special issue on skill, Ingold (2018) highlighted five questions on skill that remained unanswered. This work has gone some way in responding to three of these questions. The first two – "is skill tacit" and "is skill wordless" – both relate to my discussions of skill as communication. This does not mean that the answer is straightforwardly negative, but points to a need to further think about what is being communicated and, given this work's emphasis on material agency, why such privilege is afforded to words. Questions of whether skill defies language fail to recognise that *skill is a language.* Skill is the result of communication across a more-than-human system allowing the efficient and effective performance of collective agency. Thus, the questions become not a matter of whether skill can be captured by language, but of what the language of skill captures and what shapes it takes.

Ingold also posed the question of whether "skill confer[s] mastery" or "make[s] us vulnerable" (2018: 161). This thesis has taken a strong stance against the concept of mastery, which it sees as inherently anthropocentric. Ingold himself reaches a similar answer to that of this work, which is that to be skilled is to "submit" (ibid) to the practice. This has been seen through efforts to attune to atmospheres through distraction training and the process of learning to situate oneself in the range. Skilled practitioners, as far as this research found, were not those who sought to dominate and control, but those who were willing to be swept along. Part of this acceptance is recognising that this means allowing oneself to become vulnerable. Skill is a matter of accepting new encounters and relationships and, to return to Stewart's reflections, these will "not necessarily [be] good ones" (2011: 449).

My work further contributes to geographical debates on skill by illustrating how cybernetic concepts can provide a language through which we can discuss skill and experience in a way that decentres it from human agents. Lea (2009b) described the effort to recognise experience as being distributed across (non/in)human bodies as a central tenet to geography's engagement with

postphenomenology. Yet, as I have noted elsewhere, neo-Heideggerian modes of thinking remain prevalent in discussions of technology mediation (for example, as seen in Verbeek). These approaches privilege human actors by attributing culpability for failed integration (i.e. transparency) on nonhuman tools. Through the concepts of noise and communication, I have introduced a means to attending to skill and its disruption that can overcome this. By recognising skill not as a property that is accumulated but a measure of the entanglement of various participants, the locus for disruption equally shifts (this time away from the tool). Geographical engagement with skilled performance has frequently depicted failure as antithetical to skill (for example, O'Connor, 2007; Bissell, 2012; Straughan, 2015), yet a communicative approach opens the possibility to think of disruption as inherent to the "experimental" nature of learning (after Latham and Wagener, 2021) and the agency of nonhuman participants (Straughan, 2015). By considering disruption to be a binary opposite to skill is to only consider the perspective of the human actor. Using a more neutral language allows geographical intervention into skilled performance to take an explicitly more-than-human position.

Geographies of gender and serious leisure

This thesis has also contributed to various debates in and across geographical work on skill, performance, and bodies through its exploration of the various spaces of archery. Archery has, until now, evaded the attention of geographers, yet it is a space where complex issues around gender and (more-than-human) bodies are negotiated. Much geographical work on embodiment and serious leisure[40] has explored issues of masculinity through corporeality and often the potential for violence (Green, 2011; Anderson and Taylor, 2010; Johnston, 1995). But, despite being a weapons-based martial art, archery provide a different kind of engagement with gender. Historically, archery was considered an "acceptable" pastime for women (Jackson, 1991: 203) and during my time in the field the club maintained a roughly equal gender ratio throughout all levels of the club (including the competitive squad and committee). This is not to suggest gendering did not occur on the range, nor that archery is free of gender-based discrimination: I have noted that archers frequently gendered their bows based on preconceived – and potentially problematic – gender identities and that ArcheryGB's *Shooting Administrative Procedure* – the document outlining how archery should be conducted in the UK – is written entirely using masculine pronouns.[41] The kinds of gender politics that

[40] Understood here through the definition provided by Elkington and Stebbins (2014): "the systematic pursuit of an amateur, hobbyist or volunteer activity sufficiently substantial, interesting and fulfilling for the participant to find a (leisure) career there acquiring and expressing a combination of its special skills, knowledge and experience."

[41] Although the document states that this is an intentional decision made for clarity and consistency, this excuse rings hollow and I personally see archery's shortcoming in responding to issues of gender and

arise on the archery range are distinct, partially because they are more-than-human, but also because they are composite in nature. Both physicality and technicality (i.e., knowledge of equipment) are play a role, this is something that is not normally explored in work on marital arts (with the notable exception of Hirose and Kih-Ho Pih (2009)). Although gender has not been a core area of exploration in this work and was not an issue my participant discussed in any depth, by introducing the range as a performative space I hope to have contributed to an ongoing discussion about gender, bodies, and serious leisure that can be developed through further geographical interventions into archery. Given the nature of the issues I have noted, these may be best approached through different methods to the ones I have adopted, such as textual analysis of legislative documents.

'technologies' and 'Technology' Again

Drawing primarily on its postphenomenological and cybernetic heritage, this thesis also contributes to geographic debates around technology (such as Kullman, 2018; 2016; Ash 2015; 2013). I previously discussed the three difference Achterhuis (2001) observed between contemporary and classical approaches to philosophy of technology and have sought to reflect these through my own work. Of these changes – the movement away from speaking of 'technology uberhaupt' (Ihde, 2009), the critique of romanticised depictions of technology, and embracing the 'empirical turn' – I believe that geographers have the most to learn from the first and last. While I do not intend to suggest that geographers maintain the same transcendentalist and foundationalist views that Ihde and his contemporaries sought to reject, it nonetheless seems pertinent that geography follows postphenomenology's example.

First, I suggest that we should not talk about geographies of *technology* (e.g., Warf, 2017) but of geographies of *technologies* to reflect the diversity of nonhuman objects and processes and constitute technologies. The postphenomenological critique of 'Technology' "with a capital 'T'" (Ihde, 1993: 34) was a move to recognise that technologies had lives beyond their original design (Ihde, 2002). Geographical work has sought to recognise how artefacts are imbricated in social and material lives that extend beyond their original design and their human use (for example DeSilvey, 2007), yet there remains work to be done to ensure this is reflected in how we approach technologies. One solution is empirically oriented work, which I will turn to shortly, but another is to ensure that the nonhuman lives are foregrounded in research, and not simply relegated to a position of mediators and 'props' (Kullman, 2016). Within my research, I have endeavoured to avoid this through methods centred

transgender participation – particularly in legislative documents such as this – as one of the sports' biggest challenges moving forward. However, at no point were these issues raised by any of my participants.

around embodied participation which saw me engage with human, nonhuman, and more-than-human experiences. The time I spent tuning equipment cultivated a more-than-human attentiveness – an opportunity to learn to be affected by my equipment and to recognise its 'writing' (after Hinchliffe et al., 2005). While the writings of the water vole were footprints, latrines, and trampled grass the bow has other ways to make its presence (in the sense of *whether* it inhabits a space and *how* it inhabits that space) known. While I focused on the affective dimensions, the increased attention that sonic geographies have received of late (Paiva, 2018; see also Gallagher and Prior, 2014) indicate the potential for the sonorous experiences of tuning to be considered. The creaks, rattles, and strains of bows are all means of communication that geographers can turn to next. Using methods which foreground nonhuman experience and communication can aid geographers in attending to technologies "within a lifeworld" (Ihde, 2009) rather than as disembodied and generalisable processes.

Empirically grounding research can further ensure that geographers recognise the heterogeneous presence of technologies. My work has sought to illustrate how focusing on a particular 'case study' of a technology, an approach favoured by postphenomenologists (Rosenberger and Verbeek, 2015), provides space to attend to its particular idiosyncrasies. By situating the technology in question within a context, researchers can explore how it unfolds across its various relationships and over time. Ihde's concept of multistability is useful here as it allows us to recognise that even a singular artefact is not a singular thing but possesses "diverse and ambiguous" forms and futures. (1993: 14). I chose to focus on the archer's bow yet was only able hint at aspects of its (past, future, and present) lives. This work has not attended to the bow as a weapon, nor the bow as a historical artefact – both areas which could provide rich cultural and historical findings. But, by limiting the scope of my research, I have been able to make claims grounded in a particular technology with a specific context and thus attempt to avoid unfounded generalisation.

10.2 Geography: Cybernetics' spiritual successor?

While explicitly geographical in nature, this thesis has looked far beyond the traditional boundaries of the discipline. I have primarily drawn on the fields of cybernetics, social and cultural anthropology, and philosophy of technology but have also mobilised concepts from cognitive psychology, biomedicine, sports science, and the creative industries to name but a few fields. Earlier in this thesis,

I noted Wiener's position that the most promising areas of research likely lay in the "no-mans land" [sic] between established disciplines (Wiener, 1948: 8). His claim has been remarkably prescient, and the fusion of fields often thought to be antipodes is increasingly commonplace. Barad's (2007) work in uniting – or re-uniting, as she claims – philosophy and physics is a prominent example of this. When it comes to the study of the human use of technology, one could argue, as Law (2006) does, that an inter- or trans-disciplinary approach is necessary to provide a holistic understanding. To exclusively rely on the 'hard' sciences would forego any consideration of human behaviour, while the social sciences have been known to overlook the importance of engineering of the technology itself and either approach would likely fail to see how the two interact.

Research that overflows disciplinary boundaries – intentionally or otherwise – undoubtedly faces challenges, not the least of which is the linguistic barrier brought about by the use of technical terminology (Montagnini, 2013). Methodologically, this was a challenge for the research. My own background provided some help; a rudimentary understanding of maths and IT, recalled from my A levels in the subjects, allowed me to at least grasp at a broad understanding of what the more mathematically inclined cyberneticians, such as Wiener, were working towards, if not a full comprehension of how they were doing it. The pages of advanced equations (e.g. in Wiener, 1948) were largely impenetrable, but the narrative of their applications, in the context of entropy, feedback, or noise, were not. Elsewhere, the topics of my discussion – most notably postphenomenological enquiries into technology, and debates on skill – were inherently transdisciplinary, as evidenced by prior geographical interventions. Much of the geographical work on the latter stems from Ingold's anthropological work – culminating in Ingold himself contributing to *Cultural Geographies'* special issue on skill (Ingold, 2018) – and those that Ingold takes influence from, such as Gibson (1979). The influence of Ihde's work in geography is substantially smaller (Ash and Simpson, 2016), but nonetheless present (see for example, Kullman, 2016) and continues to grow (Lea, 2020).

Thus, it is not without reason that geography has been described as a 'magpie discipline' (Bell, 2009). While lacking the clear-cut transdisciplinary origins of cybernetics, which is arguably as much a product of interdisciplinarity as it is a vehicle for it ((Montagnini et al., 2016), geography's intersections with other disciplines, particularly the 'cognate disciplines' such as sociology and anthropology, means it 'plays well with others.' Therefore, in many senses, geography is a fitting spiritual successor to cybernetics: at their heart, each is an effort to explore the distribution and interaction of relationships, experience, agency, people, things, and information. But they also share a history marred with military applications and colonial influence. While cybernetics has been shunned for this (Pickering, 2010), geography has chosen to confront its past in such a way that it may be able to carry forward the legacy cybernetics hoped to create while remaining critical of its own failings. So, while I have often relied on

work produced outside of geography's walls, it has been done with a geographical inflection – the arguments made are geographical in nature and those concepts and theories that I have borrowed have, if not been at home in geography, then productively pushed the discipline's boundaries. I suggest that the act of reaching outside of the discipline to draw fresh ideas and alternate perspectives in, is not un-geographical but rather, as with cybernetics, a core value of geography.

10.3 Research Outputs

In this section I briefly outline some of the key applications of my research. Just as I have argued that my research draws on a diverse range of fields, it so to as a diverse range of applications. Here I look at how I have used it as both method and subject for the communication of research, discussions of skill in space travel and interplanetary colonisation, and as a wellbeing resource for students that I produced in association with the University of Exeter Wellbeing team who I have worked for alongside my PhD.

Interactive Poster Series

To communicate the visual/experiential aspects of my research, I sought to create a series of interactive posters where participants could actively engage with the ideas I was discussing. The first of these, *Secret Lives of Technology*, was presented in 2017 and demonstrated Ihde's concept of multistability. The poster used two pairs of colour lenses – one red and one blue – and a series of colour encoded images that changed depending on which lenses were being worn. This provided an engaging way to provoke students into thinking about their 'viewpoints' when they approach technologies. The poster looked at how social media can help alienate people or bring them together, how fitness trackers can encourage healthy behaviour or reinforce negative relationships with food, and how the steepness of a roadside curb at a crossing can either advantage or disadvantage wheelchair users or the visually impaired. The poster sought to encourage people to think about how their experiences with technology might differ from those of another and to show that technologies were not inherently positive or negative but must be considered within their cultural contexts.

Figure 21 Photograph of AR poster (from Twitter)

Colonising Mars: Ecological skill in hostile environments

This written submission to Mars Settlement Workshop (2018) explored how we could use ecological understandings of skill, along with experience of Antarctic research, to anticipate some of the challenges of exploring hostile environments. My work argued that an ecological understanding of skill locates the foundations of any skilled performance in the (economic, social, political, ecological etc.) environment. Drastic changes to that environment will not only create new challenges, but trigger a widespread, temporary, process of deskilling. I pointed to Arthur White's (1989) *Confessions of a Frozen Zoologist,* a brief article in which White reflects on his experience of travelling to work in the Antarctic. White notably contrasts the difference between new arrivals, such as himself, and those who had been there for some time, stating that

> "The people were not what I expected. They were hardy and tended not to get too disturbed by the climatic extremes. They regarded us with some amusement. We were nearly always over-clothed and sweating. We were clumsy on our feet and slow to move. They were not." (White, 1989: 97)

White's description of a need to acclimatise to the environment itself is echoed by the experience of NASA's own astronauts. While weight changes in space, as it is gravity-dependent, inertia does not (for NASA's research onto this, see Kubis et al, 1972). This means astronauts can struggle to walk without falling over, particularly when combined with the impact of low- or zero-gravity on the parts of the ear responsible for balance (Lafrance, 2015). Ultimately, this means the correlation between the amount of force you feel as though you are putting into a movement and the resultant movement are not correlated as they are on Earth. Recently, Scott Kelly's return after nearly a full year in space showed how the re-acclamation works both ways (Potenza, 2017), but the disproportionate experience of Earth's gravity will significantly reduce the time taken to readjust back.

This piece concluded that all skills – particularly fine-motor skills – would need to be re-learnt for every gravity change and that space travel could not assume otherwise. This is of particular importance for skills which may be required in life-or-death scenarios, such as engineering or surgery. By pointing to what I learnt from archery's distraction training approach, I propose a need to develop "nested redundancies" (Sternad, 2018) within those skills to sensitise practitioners to environmental changes and help them adjust accordingly.

Skill in a Global Pandemic: Wellbeing Resources

Throughout the course of my PhD I have worked as part of the University of Exeter's Wellbeing team, specialising in peer-to-peer student support. Following the advent of the COVID-19 pandemic I produced two wellbeing resources that drew on my understanding of skill to explain why student's might find it harder to accomplish day-to-day tasks. Much like the Mars piece, this situated skill in a broader environment and identified the pandemic as a significant disruption to that. The first resource, a blog post, explained this interpretation and encouraged readers to re-establish routine as much as possible. The second resource was a poster that suggested specific ways one may establish a routine to try and rebuild the damaged ecology of skill. These two resources revised my work for a lay-audience and brought into conversation with my experience working the mental health sector. It also further demonstrated the wide range of applications that my findings can have. Both pieces were hosted by the University of Exeter and the blog post was additionally published by UPP, a leading university residences provider.

10.4 Future Research

The transdisciplinary nature of this work means that it can be re-applied to a wide variety of contexts. This chapter explores three possible avenues for further research to build on my findings and explains how they contribute to wider literature. These projects are ones which could be undertaken with my background and training, and so do are limited in their consideration of the wide application of this research to significantly different fields.

Aesthetics and Prosthetics

My research thus far has concluded that aesthetic design and customisability play an important role in skilled performance with technology; a future research project could develop this by investigating its applicability in biomedical prosthetics use. This work would draw on debates around the use of 'incorporation' as an understanding of prosthetics use (e.g. De Preester and Tsakiris, 2009; Holmes, 2012) by drawing on vital materialist perspectives to argue for a greater need to appreciate the agency of the 'prosthetic.' From this position, it would seek to cultivate new and more cooperative relationships between a prosthetic and its user using my communicative model of skill. Multiple

themes throughout the thesis would be re-applied, but most notably those from chapters four and nine.

This would further contribute to geographical work around the limits of the body (see Abrahamsson and Simpson, 2011) and post-phenomenological understandings of the distribution of experience (per Lea, 2009b). It would also speak to debates in spectral geographies through the experience of phantom limb syndrome in ways like Sobchack's phenomenological account of her own experiences of phantom limb pain (2010).

The project could also have non-academic outputs by partnering with an organisation such as Open Bionics or The Alternative Limb Project. I have previously discussed how Open Bionics designs themed prosthetic limbs for children, a demographic within which the rejection rate for prosthetics is high (Al adwan et al., 2016). Through this partnership the project would focus on improving the acceptance rate by re-framing the prosthetics limb as a companion tool rather than a replacement limb – the latter, I would argue, setting an impossibly high bar. By recognising the agency of the prosthetic, it becomes possible to direct efforts into cultivating different kinds of relationship where the mental health issues that can arise from limb difference, and thus contribute to a higher rejection rate, can be aided by encouraging a more playful relationship.

Skill in hostile environments

My work on skill in hostile environments has only become more relevant since I first wrote about it for the Mars Settlement workshop. The possibilities of exploring, and building on, other celestial bodies is one which is increasingly discussed (such as in Shchulze-Makuch and Irwin, 2018; Bannova and Camba, 2018) which would involve astronauts experiencing a minimum of three different gravity levels (Earth's, zero and near-zero gravity in space, and the planetary gravity at the site) and thus needing to appreciating how day-to-day and specialist tasks can be adapted accordingly. Extended periods of extra-terrestrial habitation introduce problems that space agencies are yet to encounter – namely that zero gravity conditions can be replicated by inducing a state of freefall, but specific gravity conditions could not be replicated so simply. A future project could explore how spacefaring skilled performers could train to retain their skills through a myriad of changing circumstances by building on the idea of productive noise that I discussed through the example of distraction training in chapter eight.

Looking closer to home, we can expect significant changes to our way of life becoming more prevalent; climate change, antibiotic resistant superbugs, and viral pandemics are but a few such issues. Building on the same themes as the Mars work, I could explore the skill-loss I predict would occur during large-

scale disruptions to the ecology of skill and seek ways to reduce the impact. One avenue would be to identify whether there is an increase in workplace-accidents and, if so, produce updated risk assessments. Alternatively, I could continue the applications to mental health and develop more self-help resources. These approaches would continue to develop the affective atmospheres work I began in chapter eight by bringing them into conversation with geographical work on risk management and science communication

*****

As these three examples demonstrate, the possibilities for future work to build upon the concepts I have generated in this thesis are wide ranging. For as long as we continue to rely on technology for our day-to-day lives, the need for us to better understand the configuration of human-technology relations will only grow. The equitable nature of the companionship model of human-technology relations and communicative approach to understanding skill both demonstrate ways that we can move forward to understand technology in a way that helps us develop an appreciation of nonhuman agency – an appreciation that could spark significant changes in how we design new technologies.

Reference List

Aagaard, J., Friis, J., Sorenson, J., Tafdrup, O., and Hasse, C. (2018) *Postphenomenological Methodologies: New Ways in Mediating Techno-Human Relationships*, London, Lexington Books.

Abrahamsson, S. and Simpson, P. (2011) The Limits of the Body: Boundaries, Capacities, Thresholds, *Social and Cultural Geography*, 12(4): 331-338.

Achterhuis, H. (2001) *American Philosophy of Technology: the Empirical Turn,* Indiana University Press, Bloomington.

Adams, E. (2018) How to Become a Beekeeper: Learning and Skill in Managing Honeybees, *Cultural Geographies,* 25(1): 31-47.

Adams, P. (2007) Introduction to Technological Change: A Special Issue of Ethics, Place and Environment, *Ethics, Place and Environment,* 10(1): 1-6.

Adler, P. and Adler, P. (1987) *Membership roles in field research,* Sage, Newbury Park, California.

Al adwan, M., Najjar, Y., Hdaib, M. and Khateeb, M. (2016) Variables Affecting Amputees' Reaction to the Artificial Limbs in the Kingdom of Jordan, *EC Orthopaedics*, 4(4): 587-599

Ahmed, S. (2006) *Queer Phenomenology*, Duke University Press, London.

Ahmed, S. (2007) A phenomenology of whiteness, *Feminist Theory*, 8(2): 149-168.

Alač, M. (2005) Widening the Wideware: An Analysis of Multmodel Interaction in Scientific Practice, *Proceedings of the Annual Meeting of the Cognitive Science Society*, 27: 85-90.

Alcoff, L. (1999) Towards a phenomenology of racial embodiment, *Radical Philosophy, <https://www.radicalphilosophy.com/article/towards-a-phenomenology-of-racial-embodiment>* last accessed 12/06/2021.

Al-Saji, A. (2017) Feminist phenomenology, in Garry, A., Khader, S., and Stone, A. (eds) *The Routledge Companion to Feminist Philosophy*, Routledge, London.

Allen-Collinson, J. (2013) Autoethnography as the engagement of self/other, self/culture, self/politics, selves/futures in Holman, S., Adams, T. and Ellis, C. (eds), *Handbook of Autoethnography.* Left Coast Press, Walnut Creek, California, 281-299.

Allen-Collinson, J. (2012) Autoethnography: Situating Personal Sporting Narratives in Socio-Cultural Contexts, in Young, K. and Atkinson, M. (eds) *Qualitive Research on Sport and Physical Culture: Volume Six*, Emerald Group Publishing Ltd, Bingley, 191-212.

Allen-Collinson, J. and Hockey, J. (2011) Feeling the Way: Notes Toward a Haptic Phenomenology of Distance Running and Scuba Diving, *International Review for the Sociology of Sport,* 46(3): 330-345.

Allen-Collinson, J. and Hockey, J. (2008) Autoethnography as 'Valid' Methodology? A Study of Disrupted Narratives, *International Journal of Interdisciplinary Social Science*, 3(6): 209-217.

Anderson, B. (2009) Affective Atmospheres, *Emotion, Space and Society*, 2: 77-91.

Anderson, B. and Toila-Kelly, D. (2004) Matter(s) in Social And Cultural Geography, *Geoforum*, 35(6): 669-674.

Anderson, B. and Wylie, J. (2009) On Geography and Materiality, *Environment and Planning A: Economy and Space*, 41(2): 318-335

Anderson, J. (2004) Talking Whilst Walking: A Geographical Archaeology of Knowledge*, Area*, 36(3): 254-261.

Anderson, L. (2006) Analytic autoethnography, *Journal of Contemporary Ethnography*, 35(4): 373-395.

Anderson, L. and Taylor, J (2010) Standing Out While Fitting In: Serious Leisure Identities and Aligning Actions Among Skydivers and Gun Collectors, *Journal of Contemporary Ethnography,* 39(1): 34-59.

Anderson, J. (2012) Relational Places: The Surfed Wave as an Assemblage and Convergence*, Environment and Planning D: Society and Space*, 30(4): 570-587.

Angus, T., Cook, I. and Evans, J. (2001) A Manifesto for Cyborg Pedagogy*, International Research in Geographical and Environmental Education,* 10(2): 195-201.

Archery GB, (2017) *Shooting Administration Procedures*, last accessed 28th November 2020 <https://www.archerygb.org/wp-content/uploads/2017/05/Proc-02-04-SAP-Feb-20201.pdf>

Archery360 (20th September 2016) *What Fired You Up To Try Archery? The Answer Might Surprise You,* last accessed 23rd November 2020 <https://archery360.com/2016/09/20/fired-try-archery-answer-might-surprise/>

Archery360 (9th August 2013) *18.9 Million Americans Participate in Archery*, last accessed 23rd November 2020, <https://archery360.com/2013/08/09/18-9-million-americans-participate-in-archery/>

Arthur, L. (2010) Insider-Outsider Perspectives in Comparative Education, Seminar presentation at the Research Centre for International and Comparative Studies, Graduate School of Education, University of Bristol, Bristol, November 2nd.

Ash, J. (2020) Post-Phenomenology and Space: A Geography of Comprehesnion, Form and Power, *Transactions of the Institute of British Geographers,* 45(1): 181-193.

Ash, J. (2017) Visceral Methodologies, Bodily Style and the Non-human, *Geoforum,* 82: 206-207.

Ash, J. and Anderson, B. (2015) Theorizing Studio Spaces: Spheres and Atmospheres in Videogame Design Studio, in Wilkie, A. and Ignacio, F. (eds) *Studio Studies: Operations, Topologies and Displacements*, Taylor and Francis, London, 91-104.

Ash, J., Anderson, B., Gordon, R. and Langley, P. (2018) Unit,, Vibration, Tone: A Post-Phenomenological Method for Researching Digital Interfaces, *Cultural Geographies,* 25(1): 165-181.

Ash, J. and Gallacher, L. (2014) Becoming Attuned: Objects, Affects, and Embodied Methodology, in Perry, M. and Liliana Medina, C. (eds) *Methodologies of Embodiment: Inscribing Bodies in Qualitative Research*, Routledge, London, 69-85.

Ash, J. and Simpson, P. (2019) Postphenomenology and Method: Styles for Thinking the (Non)human, *Geohumanities,* 5(1): 139-156.

Ash, J. and Simpson, P. (2016) Geography and Post-Phenomenology, *Progress in Human Geography,* 40(1): 48-66.

Ashby, W. (1956) *An Introduction to Cybernetics*, Chapman and Hall, London.

Ashby, R. and Conant, E. (1970) Every Good Regulator of a System Must be a Model of That System, *International Journal of Systems Science*, 1(2): 89-97.

Atlan, H. (1974) On a Formal Definition of Organization, *Journal of Theoretical Biology*, 45: 295-304.

Auger, J. (2013) Speculative Design: Crafting the Speculation, *Digital Creativity*, 24(1): 11-35.

Baldwin, T. (2004) Merleau-Ponty's Prospectus of His Works, in Baldwin, T. (ed) *Maurice Merleau-Ponty: Basic Writings,* Routledge, London, 33-42.

Ballard, J.G. (1975) *Crash*, Jonathan Cape, London.

Bannova, O. and Camba, J. (2018) Mars Surface and Transit Habitat Commonality: Design Considerations, *Earth and Space 2018: Engineering for Extreme Environments*, 183-192.

Barad, K. (2012) On Touching – the Inhuman that Therefore I Am, *Differences: A Journal of Feminist Cultural Studies*, 23(3): 206-223.

Barad, K. (2007) *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning,* Duke University Press, Durham.

Barad, K. (2003) Posthumanist Performativity: Toward an Understanding of How Matter Came to Matter, *Signs*, 28(3): 801-831.

Barratt, P. (2012) "My magic cam": a more-than-representational account of the climbing assemblage, *Area,* 44(1): 46-53.

Barratt, P. (2011) Vertical Worlds: Technology, Hybridity and the Climbing Body, *Social and Cultural Geography,* 12(4): 397-41.

Barthes, R. (1988) *Roland Barthes,* Macmillan, London.

Bateson, G. (1972) *Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution and Epistemology,* Chandler, San Fransisco.

Baum, C. (1991) Addressing the Needs of the Cognitively Impaired Elderly from a Family Policy Perspective, *American Journal of Occupational Therapy*, 45(7): 594-606Bell, D. (2009) Cultural Studies and Human Geography, in Kitchen, R. and Thrift, N. (eds.) *International Encyclopaedia of Human Geography*, Elsevier, Oxford, 437-441.

Bavaud, F. (2009) Information Theory, Relative Entropy and Statistics, in Sommaruga, G. (ed) *Formal Theories of Information,* Springer, Berlin, 54-78.

Bawden, M. and Maynard, I. (2001) Towards an Understanding of the Personal Experience of the 'Yips' in Cricketers, *journal of Sports Sciences,* 19(12): 937-953.

BBC (2016) Planet Earth II, produced by Berlowitz, V., Gunton, M., Brickwell, J. and Hugh-Jones, T.

Becker, H. (2007) *Telling About Society*, Chicago university Press, Chicago.

Beer, S. (1972) *Brain of the Firm*, Penguin, London.

Beer, S. (1968) *Management Science: The Business Use of Operations Research*, Doubleday, New York.

Beilock, S. (2008) Math Performance in Stressful Situations, *Current Directions in Psychological Science*, 17(5): 339-343.

Bell, D. (2009) Cultural Studies and Human Geography, in Kitchin, R. and Thrift, N. (eds) *International Encyclopaedia of Human Geography*, Elsevier Science, London 437-441

Bennett, J (2010) *Vibrant Matter: A Political Ecology of Things*, Duke University Press, Durham.

Bennett, J. (2004) The Force of Things: Steps Toward an ecology of Matter, *Political Theory*, 32(3): 347-372.

Bernstein, N. (1996) *On Dexterity and Its Development,* in Latash, M. and Turvey, M. (eds) *Dexterity and Its Development*, L Erlbaum Associates, New Jersey, 3-244.

Bille, M. (2015) Hazy Worlds: Atmospheric Ontologies in Denmark, *Anthropological Theory*, 15(3): 257-274.

Bingham, N. (2006) Bees, Butterflies, and Bacteria: Biotechnology and the Politics of Nonhuman Friendship, *Environment and Planning A: Economy and Space,* 38(3): 483-498

Bingham, P. (2000) Human Evolution and Human History: A Complete Theory, *Evolutionary Anthropology,* 9:248-257.

Bissell, D. (2012) Habit Displaced: The Disruption of Skilful Performance, *Geographical Research,* 51: 120-129.

Bissell, D. (2009) Obdurate Pains, Transient Intensities: affect and the Chronically Pained Body, *Environment and Planning A: Economy and Space,* 41(4): 911-928.

Black, D. (20014) Where Bodies End and Artefacts Begin: Tools, Machines and Interfaces, *Body and Society*, 20(1): 31-60.

Blain, L. (2014) In Pictures: Singapore's Surreal Supertree Grove and Cloud Forest, *New Atlas*, last accessed 29th November 2020, <https://newatlas.com/singapore-gardens-by-the-bay-supertree-cloud-forest/33590/>

Blommaert, J and Jie, D. (2010) *Ethnographic Fieldwork: A Beginner's Guide*, Multilingual Matters, Bristol.

Blue, G. and Rock, M. (2020) Genomic trans-biopolitics: Why more-than-human geography is critical amid the COVID-19 pandemic, *Dialogues in Human Geography*, 10(2): 287-290.

Bogost,I. (2012) *Alien Phenomenology, or What It's Like to Be a Thing,* University of Minnesota Press, Minneapolis.

Böhme, G. (1995) Atmosphare: Essays zur neuen Asthetik, Suhrkam, Frankfurt.

Borkfelt, S. (2011) What's in a Name? – Consequences of Naming Non-Human Animals, *Animals,* 1(1): 116-125.

Botvinick, M. (2004) Probing the Neural Basis of Body Ownership, *Science*, 305(5685): 782-783.

Botvinick, M. and Cohen, J. (1998) Rubber Hands 'Feel' Touch that Eyes See, *Nature*, 391: 756.Brown, B. (2004) *A Sense of Things*, University of Chicago Press, Chicago.

Braidotti, R. (2013) *The Posthuman*, John Wiley and Sons, London.

Bremer, S. (2013) Penis as risk: A Queer phenomenology of two Swedish transgender women's narratives on gender correction, *Somatechnics*, 3(2): 329-250.

Brice, S. (2018) Situating Skill: Contemporary Observational Drawing as a Spatial Method in Geographical Research, *Cultural Geographies*, 25(1): 135-158.

Brown, K., Marean, C., Jacobs, Z., Schoville, B., Oestmo, S., Fisher, E., Bernatchez, J., Karkanas, P. and Matthews, T. (2012) An Early and Enduring Advanced Technology Originating 71,000 Years Ago in South Africa, *Nature,* 491: 590-593.

Brown, S. (2002) Michel Serres: Science, Translation and the Logic of the Parasite, *Theory, Culture and Society,* 19(3): 1-27.

Brownlow, A. (2005) A geography of men's fear, *Geoforum*, 36(5): 581-592.

Bruner, E. (1997) Ethnography as Narrative, in Hinchman, L. and Hinchman, S. (eds) *Memory, Identity, Community: The Idea of Narrative in the Human Sciences*, SUNY Press, New York, 264-280.

Bruner, J. (1986) *Actual Minds, Possible Worlds*, Harvard University Press, Cambridge.

Bryman, A. (2008) *Social Research Methods*, Oxford University Press, Oxford.

Buller, H. (2015) Animal Geographies III: Ethics, *Progress in Human Geography*, 40(3): 422-430.

Buller, H. (2014) Animal Geographies II: Methods, *Progress in Human Geography*, 39(3): 374-384.

Buller, H. (2013) Animal Geographies I, *Progress in Human Geography*, 38(2): 308-318.

Butryn, T. and Masucci, M. (2009) Traversing the Matrix: Cyborg Athletes, Technology, and the Environment, *Journal of Sport and Social Issues*, 33(3): 285-307.

Canzoneri, E., Ubaldi, S., Rastelli, V. and Finisguerra, A. (2013) Tool-Use Reshapes the Boundaries of the Body and Peripersonal Space Representations, *Experimental Brain Research*, 228(1): 25-42.

Cariani, P. (2010) On the Importance of Being Emergent, *Constructivist Foundations,* 5(2): 86-91.

Carijó, F., de Almeida, M. and Kastrup, V. (2013) On Haptic and Motor Incorporation of Tools and Other Objects, *Phenomenology and the Cognitive Sciences,* 12(4): 685-701/

Cardinali, L., Frassinetti, F., Brozzoli, C., Urquizar, C., Roy, A. and Farnè, A. (2009) Tool-Use Induces Morphological Updating of the Body Schema, *Current Biology*, 19(12): 478-479.

Carolan, M. (2008) More-than-Representational Knowledge/s of the Countryside: How We Think as Bodies, *Sociologia Ruralis,*48(4): 408-422.

Carpiano, R. (2009) Come Take a Walk With Me: The "Go-Along" Interview as a Novel Method for Studying the Implications of Place for Health and Well-being, *Health and Place*, 15(1): 263-272.

Chahine, L. and Kanazi, G. (2007) Phantom Limb Syndrome: A Review*, Middle Eastern Journal of Anaesthesiology*, 19(2): 345-355.

Chakrabarty, M. (2015) A Philosophical Study of Human-Artefact Interaction*, AI & Society*, 32: 267-274.

Chandler, J. and Schwarz, N. (2010) Use Does Not Wear Ragged the Fabric of Friendship: Thinking Objects as Alive Makes People Less Willing to Replace Them, *Journal of Consumer Psychology*, 20(2): 138-145.

Chalmers, D. (2008) Foreword, in Clark, A., *Supersizing the Mind*, Oxford University Press, Oxford.

Chare, N. (2005) Regarding the Pain: Noise in the Art of Francis Bacon, *Angelaki*, 10: 133-143.

Charmaz, K. and Mitchell, R. (1997) The myth of silent authorship: self, substance, and style in ethnographic writing, *Symbolic Interaction*, 19(4): 285-302.

Chatham-Carpenter, A. (2010) 'Do theyself no harm": protecting ourselves as autoethnographers, *Journal of Research Practice*, 6(1): 1-13.

Churchill, S. (1993) Weapon Technology, Prey Size Selection and Hunting Methods in Modern Hunter-Gatherers: Implications of Hunting in the Palaeolithic and Mesolithic, *Archaeological Papers of the American Anthropological Association,* 4(1): 11-24.

Churchill, S. and Rhodes, J. (2009) The Evolution of the Human Capacity for 'Killing at a Distance': The Human Fossil Evidence for the Evolution of Projectile Weaponry, in Hublin, J. and Richards, M. (eds) *The Evolution of Hominin Diets,* Springer, Dordrecht.

Clark, A. (2008) *Supersizing the Mind*, Oxford University Press, Oxford.

Clark, A. (2003) Artificial Intelligence and the Many Faces of Reason, in Sitch, S. and Warfield, T. (eds) *The Blackwell Guide to Philosophy of Mind,* Blackwell, London, 309-330.

Clark, A. (1999) An Embodied Cognitive Science? *Trends in Cognitive Science,* 3(9): 345-351.Green, K (2011) It Hurts so it is Real: Sensing the Seduction of Mixed Martials Arts, *Social and Cultural Geography,* 12(4): 377-396.

Clark, A. (1989) *Microcognition*, MIT Press, Cambridge.

Clark, A. and Chalmers, D. (1998) The Extended Mind*, Analysis,* 58(1): 7-19.

Clark, A. and Emmel, N. (2008) Walking Interviews: More than Walking and Talking, presented at *'Peripatetic Practices': A Workshop on Walking,* London, March.

Clarke, B. and Hansen, M. (2009) Neocybernetic Emergence: Returning the Posthuman, *Cybernetics and Human Knowing*, 16(1-2): 83-99.

Clarke, P., Sheffield, D. and Akehurst, S. (2020) Presonality Predictors of Yips and Choking Suscptibility*, Frontiers in Psychology*, 10: 2784.

Clarke, P., Sheffield, D. and Akehurst, S. (2015) The Yips in Sport: A Systematic Review, *International Review of Sport and Exercise Psychology*, 8(1): 156-184.

Clynes, M. and Kline, N. (1960) Cyborgs and Space, *Astronautics*, September issue*:* 26-27, 74-76.

Cohen, E. (2006) Kime and the Moving Body: Somatic Codes in Japanese Martial Arts, *Body and Society,* 12(4): 73-93.

Cole, M. and Derry, J. (2005) We Have Met Technology and It Is Us, in Sternberg, R. and Preiss, D. (eds) *Intelligence and Technology: The Impact of Tools on the Nature and Development of Human Abilities*, Routledge, New York, 209-227.

Conway, F. and Siegelman, J. (2005) *Dark Hero of the Information Age: In Search of Norbert Wiener, the Father of Cybernetics*, Basic Books, New York.

Cook, I. (2001) 'You Want to Be Careful You Don't End Up Like Ian. He's All Over the Place': Autobiography In/Of An Expanded Field, in Moss, P. (ed) *Placing Autobiography in Geography*, Syracuse University Press, New York, 99-120.

Coole, D. and Frost, S. (2010) *New Materialisms: Ontology, Agency, and Politics*, Duke University Press, London.

Coote, A., Franklin, J., Simms, A. and Murphy, M. (2010) 21 Houses: Why a Shorter Working Week Can Help Us All to Flourish in the 21st Century, *Journal of Industrial Ecology,* 9(1-2): 51-67.

Cowley, J and Vallée-Tourangeau, F. (eds) (2017) *Cognition Beyond the Brain: Computation, Interactivity, and Human Artifice*.

Crang, M. (2003) Qualitative Methods: Touchy, Feely, Look-Se?, *Progress in Human Geography*, 27(4): 494-504.

Crang, M. and Cook, I. (2007) *Doing Ethnographies*, Sage, London.

Creswell, J. (1999) Mixed-Method Research: Introduction and Application, in Cizek, G. (1999) *Handbook of Education Policy*, Academic Press, Cambridge., 455-472.

Crevier, D. (1993) *AI: The Tumultuous History of the Search for Artificial Intelligence*, Basic Books, New York.

Dant, T. and Wheaton, B. (2007) Windsurfing: An Extreme Form of Material and Embodied Interaction?, *Anthropology Today*, 23(6): 8-12

Deleuze, G. and Guattari, F. (1987) *A Thousand Plateaus: Capitalism and Schizophrenia*, University of Minnesota Press, Minneapolis.

de Laet, M. and Mol, A. (2000) The Zimbabwe Bush Pump: Mechanics of a Fluid Technology, *Social Studies of Science*, 30(2): 225-263.

De Preester, H. (2012) Technology and the Myth of 'Natural Man', *Foundations of Science*, 17: 385-390.

De Preester, H. (2011) Technology and the Body: the (Iim)Possibilities of Re-embodiment, *Foundations of Science,* 16: 119-137.

De Preester, H. (2010) Postphenomenology, Embodiment, and Technics, *Human Studies,* 33(2-3): 339-345.

De Preester, H. and Tsakiris, M. (2009) Body-extension versus body-incorporation: Is there a need for a body-model?, *Phenomenology and the Cognitive Sciences,* 8: 309-319.

del Rio, E. (2009) Film in Sepp, H. and Embree, L. (eds) *Handbook of Phenomenological Aesthetics*, Springer, Dordecht, 111-117.

Deleuze, G. and Guattari, F. (1986) *Kafka: Toward a Minor Literature*, University of Minnesota Press, Minneapolis.

Denzin, N. (2003) *Performance Ethnography: Critical Pedagogy and the Politics of Culture*, Thousand Oaks, Sage, California.

DeSilvey, C. (2007) Salvage memory: constellating material histories on a hardscrabble homestead, *Cultural Geographies*, 14(3): 401-424.

Dewsbury, J. (2010) Performative, non-representational, and affect based research: Seven injunctions, in Delsyer, D., Aitken, S., Craig, M., Hubert, S. and McDowell, L. (eds) *The SAGE Handbook of Qualitative Geography*, SAGE, London, 321-334.

Dewsbury, J. (2003) Witness Space: 'Knowledge Without Contemplation', *Environment and Planning A: Economy and Space*, 35(11): 1907-1932.

Dilkes-Frayne, E. and Duff, C. (2017) Tendencies and Trajectories: The Production of Subjectivity in an Event of Drug Consumption, *Environment and Planning D: Society and Space,* 35(5): 951-967.

Dixon, D. and Whitehead, M. (2008) Technological Trajectories: Old and New Dialogues in Geography and Technology Studies*, Social and Cultural Geography*, 9(6): 601-611.

Dowling, R., Lloyd, K. and Suchet-Pearson, S. (2017) Qualitative Methods II: 'more-than-human' methodologies and/in praxis, *Progress in Human Geography,* 41(6): 823-831.

Downey, G. (2010) 'Practice without theory': a Neuroanthropological Perspective on Embodied Learning,' *The Journal of the Royal Anthropological Institute,* 16: 22-40.

Downey, G. (2008a) Coaches as Phenomenologists: Para-Ethnographic Work in Sports, in Maxwell, I. (ed) *Being There: After-Proceedings of the 2006 Conference of the Australasian Association for Drama, Theatre and Performance Studies*, last accessed 25th November 2020 <https://ses.library.usyd.edu.au/handle/2123/2490>.

Downey, G. (2008b) Scaffolding Imitation in Capoeira: Physical Education and Enculturation in an Afro-Brazilian Art, *American Anthropologist*, 110(2): 204-213.

Downey, G. (2005) *Learning Capoeira: Lessons in Cunning from an Afro-Brazilian Art*, Oxford University Press, Oxford.

Dreyfus, H. (2002) Intelligence Without Representation – Merleau-Ponty's Critique of Mental Representation (the Relevance of Phenomenology to Scientific Explanation), *Phenomenology and the Cognitive Sciences*, 1: 367-383.

Dreyfus, H. (2001) Forward, in Sudnow, D. (ed) *Ways of the Hand: A Rewritten Account*, MIT Press, Massachusetts, 9-13.

Dreyfus, H. (1992) *What Computers Still Can't Do: A Critique of Artificial Reason,* MIT Press, Cambridge.

Dreyfus, H. (1972) *What Computers Can't Do: The Limits of Artificial Intelligence,* Harper and Row, New York.

Dreyfus, H. and Dreyfus, S. (1986) *Mind Over Machine: the Power of Human Intuition and Expertise in the Era of the Computer*, Free Press, New York.

Dreyfus, H. and Dreyfus, S. (1980) *A Five-Stage Model of the Mental Activities involved in Direct Skill Acquisition*, University of California Press, Berkeley.

Drummond, J. (1007) Phenomenology: Neither Auto- nor Hero- Be, *Phenomenology and the Cognitive Sciences*, 6(1-2): 57-74.

Dyer, S. and Demeritt, D. (2008) Un-Ethical Review? Why it is Wrong to Apply the Medical Model of Research Governance to Human Geography, *Progress in Human Geography*, 33(1): 46-64.

Eccles, D. and Tenenbaum, G. (2004) Why an Expert Team is More than a Team of Experts: A Social-Cognitive Conceptualization of Team Coordination and Communication in Sport*, Journal of Sport and Exercise Psychology*, 26(4): 542-560.

Eden, S. and Barratt, P. (2010) Outdoors Versus Indoors? Angling Ponds, Climbing Walls and Changing Expectations of Environmental Leisure, *Area,* 42(4): 487-493.

Edwards, S. (2005) Research Participation and the Right to Withdraw, *Bioethics*, 19(2): 112-130.

Ellis, C. (2007) Telling Secrets, Revealing Lives: Relational Ethics in Research with Intimate Others*, Qualitative Inquiry*, 13(1): 3-29.

Ellis, C. (1999) Heartful Autoethnography, *Qualitative Health Research*, 9(5): 669-683.

Ellis, C. (1995) Emotional and Ethical Quagmires in Returning to the Field, *Journal of Contemporary Ethnography*, 24: 711-730.

Ellingson, L. and Ellis, C. (2008) Autoethnography as a Constructionist Project, in Holstein, J. and Gubrium, J. (eds) *Handbooks of Constructionist Research*, Guilford, New York, 445-465.

Elwood, S. and Martin, D. (2000) "Placing" Interviews: Locations and Scales of Power in Qualitative Research, *The Professional Geographer*, 52(4): 649-657.

Emreson, R., Fretz, R. and Shaw, L. (1995) *Writing Ethnographic Fieldnotes*, University of Chicago Press, Chicago.

England, K. (1994) Getting Personal: Reflexivity, Positionality, and Feminist Research, *The Professional Geographer,* 46(1): 80-89.

Evens, A. (2002) Sound Ideas, in Massumi, B. (ed) *A Shock to Thought*, Routledge, London, 171-187.

Evers, C. (2019) Polluted leisure and blue spaces: More-than-human concerns in Fukushima, *Journal of Sport and Social Issues*, 45(2): 179-195.

Eysenck, M., Derakshan, N., Santos, R. and Calvo, M. (2007) Anxiety and Cognitive Performance: Attentional Control Theory, *Emotion,* 7(2): 336-353.

Fannin, M. (2011) Personal Stem Call Banking and the Problem with Property*, Social and Cultural Geography*, 12(4): 339-356.

Fanon, F. (1986) *Black Skin, White Marks*, Pluto Press, London.

Feenberg, A. (1999) *Questioning Technology,* Routledge, London.

Finch, J., Heath, G., David, A. and Kulkarni, J. (2012) Biomechanical Assessment of Two Artificial Big Toe Restorations From Ancient Egypt and Their Significance to the History of Prosthetics*, Journal of Prosthetics and Orthotics,* 24(4): 181-191.

Finlay, L. (2002) "Outing" the Researcher: The Provenance, Process, and Practice of Reflexivity, *Qualitative Health Research,* 12(4): 531-545.

Fisher, K. (2015) Positionality, Subjectivity, and Race in Transnational and Transcultural Geographical Research, *Gender, Place, and Culture*, 22(4): 456-473.

Fisher, T. and Botticello, J. (2018) Machine-made Lace, the Spaces of Skilled Practices and the Paradoxes of Contemporary Craft Production, *Cultural Geographies,* 25(1): 49-69.

Fisher, T., Donovan, N. and Botticello, J. (2016) Using 3D Animation to Capture and Preserve Intangible Heritage: Industrial Textile Crafts, *Furnace: The Postgraduate Journal of the Ironbridge International Institute for Cultural Heritage*, 3: 1-8.

Foreman, I. (2014) Spectral Soundscapes: Exploring Spaces of Remembrance through Sound, *Interference*, 4: n.p., accessed 10th May 2017< http://www.interferencejournal.org/spectral-soundscapes-exploring-spaces-of-remembrance-through-sound/>

Fox, N. and Alldred, P. (2018) New Materialism, in Atkinson, P., Delamon, S., Hardy, M. and Williams, M. (eds) *The Sage Encyclopedia of Research Methods*, Sage, London.

Fox Miller, C. (2017) The Contemporary Geographies of Craft-Based Manufacturing, *Geography Compass*, 11(4): 1-13.

Friis, J. (2015) Towards a Hermeneutics of Unveiling, in Rosenberger, R. and Verbeek, P. *Postphenomenological Investigations: Essays on Human—Technology Relations,* Lexington Books, London, 215-225.

Gallagher, M., Kanngieser, A. and Prior, J. (2017) Listening Geographies: Landscape, Affect and Geotechnologies*, Progress in Human geography*, 41(5): 618-637.

Gallagher, S. (2006) *How the Body Shapes the Mind*, Clarendon Press, Oxford.

Galli, G. Noel, J., Canzoneri, E., Blaanke, O. and Serino, A. (2015) The Wheelchair as a Fully-Body Tool Extending the Peripersonal Space, *Frontiers in Psychology*, 18(639): n.p.

Gapenne, O. and Declerck, G. (2009) Conceptualizing and Designing the Process of Appropriation: The Story of Disappearance*,* in Chakrabarti (ed) *ICORD 09: Proceedings of the 2nd International Conference on Research into Design*, 363-370, last access 25th November 2020, <https://www.designsociety.org/publication/32301/Conceptualizing+and+Designing+the+Process+of+Appropriation%3A+The+Story+of+a+Disappearance>.

Graham, S. and Thrift, N. (2007) Out of Order: Understanding Repair and Maintenance, *Theory, Culture and Society*, 24(3): 1-25.

Garrett, B. (2013) Vitalism versus Emergent Materialism, in Normandin, S. and Wolfe, C. (eds) *Vitalism and the Scientific Image in Post-Enlightenment Life Science, 1800-2010*, Springer, Dordecht, 127-154.

Gibson, J. (1979) *The Ecological Approach to Visual Perception*, Houghton Mifflin, Boston.

Giddings, S. and Kennedy, H. (2008) Little Jesuses and Fuck-Off Robots: On Aesthetics, Cybernetics, and Not Being Very Good at Lego Star Wars, in Swalwell, M. and Wilson, J. (eds) *The Pleasures of Computer Gaming: Essays on Cultural History, Theory and Aesthetics*, McFarland and Company Inc, Jefferson, 13-32.

Goodwin, C. (2000) Practices of Seeing, Visual Analysis: An Ethnomethodological Approach, in van Leeuwen, T. and Jewitt, C. (eds) *Handbook of Visual Analysis*, Sage, London, 157-182.

Green, K. (2011) 'It hurts so It Is Real': Sensing the Seduction of Mixed Martial Arts*, Social and Cultural Geography*, 12(4): 377-396

Greenhough, B (2014) More-than-human geographies, in Lee, R., Castree, N., Kitchin, R., Lawson, V., Paasi, A., Philo, C., Radcliffe, S., Roberts, S. and Withers, C. (eds) *The SAGE Handbook of Human Geography*, Sage, London, 94- 119

Gregory, D. (1978) *Ideology, Science and Human Geography,* Hutchinson, London.

Gruppetta, M. (2004) Autophenomenography? Alternative Uses of Autobiographically Based Research, *Paper Presented at the AARE Annual Conference, Melbourne.*

Guillemin, M. and Gillam, L. (2004) Ethics, Reflexivity and 'Ethically Important Moments' in Research, *Qualitative Inquiry,* 10(2): 261-280.

Hand, M., Shove, E. and Southerton, D. (2007) Home Extensions in the United Kingdom: Space, Time, and Practice, *Environment and Planning D: Society and Space*, 25(4): 668-681.

Haraway, D.(2001) A Cyborg Manifesto, in *Simians, Cyborgs and Women: The Reinvention of Nature*, Routledge, New York, 149-182.

Harman, G. (2002) *Tool-Being: Heidegger and the Metaphysics of Objects*, Open Court Publishing, Chicago.

Harris, L. and Fiske, S. (2008) The Brooms in Fantasia: Neural Correlates of Anthropomorphizing Objects, *Social Cognition*, 26(2): 210-223.

Harris, L., Todorov, A. and Fiske, S. (2005) Attributions on the Brain: Neuro-Imaging Disportional Interference Beyond Theory of Mind, *Neuroimage*, 28: 763-769.

Hasse, C. (2013) Artefacts that talk: Mediating technologies as multistable signs and tools, *Subjectivity,* 6(1): 79-100.

Haugeland, J. (1985) *Artificial Intelligence: The Very Idea*, MIT Press, Cambridge.

Hawkins, H. (2019) Geography's creative (re)turn: Toward a critical framework, *Progress in Human Geography,* 43(6): 963-984.

Hawkins, H. (2015) Creative Geographic Methods: Knowing, Representing, Intervening. On Composing Place and Page, *Cultural Geographies*, 22(2): 247-268.

Hayes-Conroy, A. (2017) Critical Visceral Methods and Methodologies, *Geoforum*, 82: 51-52.

Hayler, M. (2015) *Challenging the Phenomena of Technology*, Palgrave Macmillan, New York.

Hayler, M. (2011) *Incorporating Technology: A Phenomenological Approach to the Study of Artefacts and the Popular Resistance to E-reading*, PhD dissertation, English, College of Humanities, University of Exeter, UK.

Hayles, N. (2006) Unfinished Work: From Cyborg to Cognisphere*, Theory, Culture and Society*, 23(7-8): 159-166.

Hayles, N.K. (2002) *Writing Machines*, MIT Press, Cambridge.

Hayles, N. (1999) *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*, University of Chicago Press, Chicago.

Head, H. and Holmes, H. (1911) Sensory Disturbances from Cerebral Lesions, *Brain*, 34(2-3): 102-254.

Heersmink, R. (2020) Varieties of the Extended Self*, Consciousness and Cognition*, 85(103001): 1-12.

Heideer, F. and Simmel, M. (1944) An Experimental Study of Apparent Behaviour, *American Journal of Psychology*, 57: 243-259.

Heidegger, M. (1982) *The Basic Problems of Phenomenology,* translated by Hofstadter, A., Indiana University Press, Bloomington.

Heidegger, M. (1972) *On Being and Time*, Harper and Row Limited, New York.

Heidegger, M. (1971) *Poetry, Language and Thought,* Harper and Row, New York.

Heidegger, M. (1954) Die Frag nach der Technik, in Heidegger, M. (ed) Vorträge und Aufsätze, Neske, Pfullingen.

Henderson, R. and Woods, A. (2016) Exploring Literature Lives: Returning to the Field, *Anthropology and Education Quarterly,* 47(2): 203-212.

Hepach, M. (2021) Entangled phenomenologies: reassessing (post-)phenomenologies promise for human geography*, Progress in Human Geography*.

Herr, H., Whiteley, G. and Childress, D. (2005) Cyborg Technology – Biomimetic Orthotic and Prosthetic Technology, Bar-Cohen, Y. and Breazeal, C. (eds) *Biologically Inspired Intelligent Robots*, SPIE, Washington, 103-144.

Herzog, H. (2005) On Home Turf: Interview Location and its Social Meaning*, Qualitative Sociology,* 28(1): 25-47

Hildebrandt, M (2007) Ambient Intelligence, Criminal Liability, and Democracy, *Criminal Law and Philosophy*, 2(2): 163-180.

Hinchliffe, S. (2021) Postcolonial global health, post-colony microbes and antimicrobial resistance, *Theory, Culture and Society*.

Hinchliffe, S., Kearnes, M., Degends, M. and Whatmore, S. (2005) Urban wild things: A cosmopolitical experiment, *Environment and Planning D,* 23(5): 643-658.

Hirose, A. and Kei-ho Pih, K. (2009) Men Who Strike and Men Who Submit: Hegemonic and Marginalized Masculinities in Mixed Martial Arts, *Men and Masculinities,* 13(2) 190-209.

Hirose, N. (2002) An Ecological Approach to Embodiment and Cognition, *Cognitive Systems Research*, 3: 289-299.

Hitchings, R. (2012) People Can Talk About Their Practices, *Area*, 44(1): 61-67.

Hogan, T. and Hornecker, E. (2011) Human-Data Relations and the Lifeworld, conference paper presented at *Irish Human Computer Interaction Conference 2011*, last accessed 28th November 2020, <http://tactiledata.net/wp-content/uploads/2011/09/iHCI_11_THv5.doc.pdf>

Hollan, J., Hutchins, E. and Kirsh, D. (2000) Distributed Cognition: Toward a New Foundation for Human-Computer Interaction Research, *Transactions on Computer-Human Interaction,* 7(2): 174-196.

Holmes, N. (2012) Does Tool Use Extend Peripersonal Space? A Review and Re-Analysis, *Experimental Brain Research*, 218(2): 273-282.

Hull, J. (1997) *On sight and Insight: A Journey into the World of Blindness*, Oneworld, London.

Hunt, R. (2018) On Sawing a Loaf: Living Simply and Skilfully in Hut and Bothy, *Cultural Geographies¸25(1): 71-89.*

Husserl, E. (1973) *Experience and Judgement,* Northwestern University Press, Illinois.

Hutchins, E. and Klausen, T. (1996) Distributed Cognition in an Airline Cockpit, in Engeström, Y. and Middleton, D. (eds) *Cognition and Communication at Work,* Cambridge University Press, New York, 15-34.

Ihde, D. (2012) Postphenomenological Re-embodiment, *Foundations of Science,* 17: 373-377

Ihde, D. (2009) Introduction: Postphenomenological Research, *Human Studies*, 31(1): 1-9.

Ihde, D. (2007) *Listening and Voice: Phenomenologies of Sounds,* SUNY Press, Albany.

Ihde, D. (2003) If Phenomenology is an Albatross, is Post-Phenomenology Possible? In Ihde, D. and Selinger, E. (eds) *Chasing Technoscience: A Matrix for Materiality*, Indiana University Press, Bloomington, 131-144.

Ihde, D. (2002) *Bodies in Technology,* University of Minnesota Press, Minneapolis.

Ihde, D. (1993) *Postphenomenology: Essays in the Postmodern Context*, Northwestern University Press, Chicago.

Ihde, D. (1990) *Technology and the Lifeworld: From Garden to Earth*, Indiana University Press, Bloomington.

Ihde, D. (1979) *Technics and Praxis: A Philosophy of Technology,* Springer Netherlands*,* Dordrechet

Ingold, T. (2020) Of Work and Words: Craft as a Way of Telling*, European Journal of Creative Practices in Cities and Landscapes*, 2(2): 5-17.

Ingold, T. (2018) Five Questions of Skill, *Cultural Geographies,* 25(1): 159-163.

Ingold, T. (2017a) *Anthropology and/as Education*, Routledge, London.

Ingold, T. (2017b) On Human Correspondence, *Journal of the Royal Anthropological Institute,* 23(1): 9-27.

Ingold, T. (2011) *Redrawing Anthropology: Materials, Movements, Lines*, Ashgate, Aldershot.

Ingold, T. (2008) When ANT Meets SPIDER: Social Theory for Arthropods, in Knappett, C. and Malafouris, L. (eds) *Material Agency: Towards a Non-Anthropocentric Approach*, Springer, New York, 209-215.

Ingold, T. (2007) *Lines: A Brief History,* Routledge, Abingdon.

Ingold, T. (2006) Walking the Plank: Meditations on a Process of Skill, in Dakers, J. (ed) *Defining Technological Literacy: Towards an Epistemological Framework*, Palgrave Macmillian, London.

Ingold, T. (2000) *The Perception of the Environment: Essays on Livelihood, Dwelling and Skill*, Routledge, London.

Ingold, T. (1993) The Temporality of the Landscape, *World Archaeology*, 25: 152-174.

Ingold, T. and Vergunst, J. (2008) *Ways of Walking: Ethnography and Practice on Foot*, Ashgate Publishing Ltd, Farnham.

Iriki, A., Tanaka, M. and Iawmura, Y. (1996) Coding of Modified Body Schema During Tool Use by Macaque Postcentral Neurones, *Neuroreport,* 7(14): 2325-2330.

Jackson, R., Ashford, K. and Norsworthy, G. (2006) Attentional Focus, Dispositional Reinvestment, and Skilled Motor Performance Under Pressure, *Journal of Sport and Exercise Psychology*, 28(1): 49-68.

James, M. (2012) Autoethnography: The Story of Applying a Conceptual Framework for Internal Positioning to Public Relations Practice, *Public Relations Review*, 38: 555-564.

Jaspers, K. (1931) *Die Geistige Situation der Zeit,* de Gruter, Berlin.

Jones, O. (2005) An Ecology of Emotion, Memory, Self and Landscape, in Davidson, J., Bondi, L. and Smith, M. (eds) *Emotional Geographies*, Ashgate, Aldershot, 205-218.

Jungnickel, K. (2018) Tinkering with technology: Examining past practices and imagined futures, in Williamson, R., Rghnaill, R., Douglas, K., and Sanchez, D. (eds) *Technology and Australia's Future*, Australian Council of Learned Academies, 384-387.

Kallet, R. (2004) How to Write the Methods Section of a Research Paper, *Respiratory Care*, 49(10): 1229-1232.

Kaplan, D. (2009) How to Read Technology Critically, in Olsen, J., Selinger, E. and Riis, S. (eds) *New Waves in Philosophy of Technology*, Palgrave Macmillan, London, 83-99.

Kay, L. (2001) From Logical Neurons to Poetic Embodiments of Mind: Warren S. McCulloch's Project in Neuroscience, *Science in Context*, 14: 591-614.

Kidwell, J. (2004) *Instinctive Archery Insights,* 2nd edition, Litho Printers, Cassville.

Kiesler, S. and Goetz, J. (2002) Mental Models and Cooperation with Robotic Assistances, in *Proceedings of the ACM CH1'02 Conference on Human Factors in Computing Systems*, ACM Press, Minneapolis, 576-577.

Kinkaid, E. (2020) Is Post-Phenomenology a Critical Geography? Subjectivity and Difference in Post-Phenomenological Geographies*, Progress in Human Geography*, (print issue forthcoming).

Kinsley, S. (2014) The Matter of 'Virtual' Geographies, *Progress in Human Geography,* 38(3): 364-384.

Kiran, A. (2015) Four Dimensions of Technological Mediation, in Rosenberger, R. and Verbeek, P. (eds) *Postphenomenological Investigations: Essays on Human—Technology Relations,* Lexington Books, London, 123-140.

Kirsch, D. (1995) The Intelligent Use of Space, *Artificial Intelligence*¸72(2): 31-68.

Klenk, N. (2018) From Network to Meshwork: Becoming Attuned to Difference in Transdisciplinary Environmental Research Encounters, *Environmental Science and Policy,* 89: 315-321.

Krane, V. and Baird, S. (2005) Using Ethnography in Applied Sport Psychology, *Journal of Applied Sport Psychology,* 17(2): 87-107.

Kruger, J. (1999) Lake Wobegon be gone! The "Below-Average Effect" and the Egocentric Nature of Comparative Ability Judgements, *Journal of Personality and Social Psychology*, 77(2): 221-232.

Kubis, J., Elrod, J., Rusnak, R., Barnes, J. and Saxon, S. (1972) *Time and Motion Study*, NASA, Houston.

Kullman, K. (2016) Prototyping Bodies: A Post-Phenomenology of Wearable Simulations, *Design Studies*, 47: 73-90.

Küpers, W. (2005) Phenomenology of Embodied Implicit and Narrative Knowing, *Journal of Knowledge Management*, 9(6): 114-133.

Lafrance, A. (2015) Moon Bloopers, a NASA Study, *The Atlantic*, last accessed 29th November 2020, <https://www.theatlantic.com/technology/archive/2015/09/falling-all-over-the-moon/406738/>

Lajoie, C. and Douglas, E. (2020) A crip queer dialogue on sickness, *Puncta: Journal of Critical Phenomenology,* 3(2) 1-14.

Latham, A. and Wagner, L. (2021) Experiments in becoming: corporeality, attunement, and doing research, *Cultural Geographies*, 28(1): 91-108.

Latour, B. (2005) Reassembling the Social: An Introduction to Actor-Network Theory, Oxford University Press, Oxford.

Latour, B. (2004) *Politics of Nature: How to Bring the Sciences into Democracy*, Harvard University Press, Cambridge.

Latour, B. (1993) *We Have Never Been Modern,* Harvard University Press, Cambridge.

Latour, B. (1988) *The Pasteurization of France*, Harvard University Press, Cambridge.

Laughlin, C. (1997) The Evolution of Cyborg Consciousness, *Anthropology of Consciousness,* 8: 144-159.

Laurier, E. (2013) Becoming a Barista, in Tora, A. and Scambler, G. (eds) *Café Society*, Palgrave Macmillan, New York, 127-145.

Laurier, E. (2010) Participant Observation, in Clifford, N., French, S. and Valentine, G. (eds), *Key Methods in Geography,* Sage, London, 116-130.

Law, J. (2008) Actor-Network Theory and Material Semiotics, in Turner, B. *The New Blackwell Companion to Social Theory*, Blackwell, Oxford.

Law, J. (2006) Networks, Relations, Cyborgs: On the Social Study of Technology, in Read, S. and Pinilla, C. (eds) *Visualizing the Invisible: Towards an Urban Space*, Techne Press, Amsterdam, 84-97.

Law, J. and Singleton, V. (2005) Object Lessons, *Organization*, 12(3): 331-355.

Lea, J. (2020) Post-Phenomenology/Post-Phenomenological Geography, in Kobayashi, A. (ed) *International Encyclopedia of Human Geography,* Elsevier, Amsterdam, 333-338.

Lea, J. (2009a) Liberation or Limitation? Understanding Iyengar Yoga as a Practice of the Self, *Body and Society,* 3(15): 71-92

Lea, J. (2009b) Post-phenomenology/post-phenomenological geographies, in Kitchen, R. and Thrift, N. (eds.) *International Encyclopaedia of Human Geography*, Elsevier, Oxford, 373-378.

Lea, J., Philo, C. and Cadman, L. (2015) "It's a Fine Line Between Self Discipline, Devotion and Dedication": Negotiating Authority in the Teaching and Learning of Ashtanga Yoga, *Cultural Geographies,* 23(1): 69-85.

Leary, M. (1992) Self-Preservational Processes in Exercise and Sport, *Journal of Sport and Exercise Psychology*, 14: 339-354.

Leder, D. (1990) *The Absent Body*, University of Chicago Press, Chicago.

Lewis, N. (2000) The Climbing Body, Nature and the Experience of Modernity, *Body and Society*, 6(3-4): 58-80.

Lindner, K. (2012) Questions of embodied difference: Film and Queer phenomenology, *European Journal of Media Studies*, 1(2): 199-217.

Lingis, A. (1998) *The Imperative,* Indiana University Press, Indiana.

Lister, M., Dovey, J., Giddings, S. and Grant, I. (2003) *New Media: A Critical Introduction*, Routledge, London.

Livingston, E. (2008) *Ethnographies of Reason (Directions in Ethnomethodology and Conversation Analysis,* Ashgate, Aldershot.

Lofland, J. (1971) *Analyzing social settings: A guide to qualitative observations and analysis,* Wadsworth, Belmont, California.

Lombard, M. and Philipson, L. (2010) Indications of Bow and Stone-tipped Arrow use 64,000 Years Ago in KawZulu-Natal, South Africa, *Antiquity¸84(325): 635-648.*

Longhurst, R. (2010) Semi-Structured Interviews and Focus Groups, in Clifford, N., French, S. and Valentine, G. (eds) *Key Methods in Geography*, Sage, London, 103-115.

Lorimer, H. (2008) Cultural geography: non-representational conditions and concerns, *Progress in Human Geography,* 32(4): 551-559.

Lorimer, H. (2005) Cultural Geography: The Busyness of Being More-than-representational, *Progress in Human Geography*, 29(1): 83-94.

Lotze, R. (1885) *Microcosmus: an Essay Concerning Man and His Relation to the World*, T &T Clark, Edinburgh.

Luczak, H., Roetting, M. and Schmidt, L. (2003) Let's Talk: Anthroporphization as a Means to Cope With Stress of Interacting with Technical Devices, *Ergonomics*, 46: 1361-1374.

Lynch, M. (2012) Seeing Fish, in Tolmie, P. and Rouncefield, M. (eds) *Ethnomethodology at Play*, Routledge, London, n.p.

Ma, M. (2005) Becoming phenomenology: style, poetic texture, and the pragmatic turn in Gilles Deleuze and Michel Serres, *Analecta Husserliana: the Yearbook of Phenomenological research*, LXXXIV: 97-116.

MacAllister, L. (2016) *Shaping the Family, Anti-Obesity Discourses and Family Life*, PhD dissertation, Geography, College of Life and Environmental Science, Exeter.

Macpherson, H. (2010) Non-Representational Approaches to Body-Landscape Relations, *Geography Compass*, 4(1): 1-13.

Malafouris, L. (2008) Beads for a Plastic Mind: the 'Blind Man's Stick' (BMS) Hypothesis and the Active Nature of Material Culture, *Cambridge Archaeological Journal,* 18(3): 401-414.

Mangen, A. (2008) Hypertext Fiction Reading: Haptics and Immersion, *Journal of Research in Reading*, 31(4): 404-419

Mann, J. (2018) Knitting the Archive: Shetland Lace and Ecologies of Skilled Practice, *Cultural Geographies*, 25(1): 91-106.

Maravita, A. and Iriki, A. (2004) Tools for the Body (Schema), *Trends in Cognitive Science*, 8(2): 79-86.

Mark, L. (1987) Eyeheight-Scaled Information About Affordances: A Study of Sitting and Stair Climbing, *Journal of Experimental Psychology: Human Perception and Performance*, 13: 361-370.

Marx, K. (1978 [1856] Speech at the Anniversary of the People's Paper, in Tucker, R. (ed), *The Marx-Engels Reader*, Norton, London, 577-578.

Masani, P. (1990) *Nobert Wiener 1894-1964*, Springer, London

Massumi, B. (2002) *Parables for the Virtual: Movement, Affect, Sensation*, Duke University Press, Durham, North Carolina.

Masters, R., Polman, R. and Hammon, N. (1993) Reinvestment: A Dimension of Personality Implicated in Skill Breakdown Under Pressure, *Personality and Individaul Differences*, 14: 655-666.

Maturana, H. and Verla, F. (1980) *Autopoiesis and Cognition: The Realization of the Living*, Reidel, Dordrecht.

Maurer, H. and Munzert, J. (2013) Influence of attentional Focus on Skilled Motor Performance: Performance Decrement Under Unfamiliar Focus Conditions, *Human Movement science*, 32(4): 730-740.

McCormack, D. (2008) Engineering Affective Atmospheres: on the Moving Geographies of the 1897 Andree Expedition, *Cultural Geographies* 15(4): 413-430.

McCulloch, W. (2004) The Beginnings of Cybernetics, undated manuscript reproduced in Pias, C. (ed) *Cybernetics-Kybernetik: The Macy Conferences 1946-1953, Vol.2, Essays and Documents*, Diaphanes, Zurich, 345-360.

McCulloch, W. (1965) *Embodiments of Mind*, MIT Press, Cambridge.

McDaniel, K., Cummings, J. and Shain, S. (1989) The 'Yips': A Focal Dystonia of Golfers, *Neurology* 39: 192-195.

McFarlane, B. (1990) Correct the Lead Leg with Line Hurdling, *Track and Field Quarterly Review*, 90: 25.

McLuhan, M (1964) *Understanding Media: The Extensions of Man,* Sphere Books, London.

McNess, E., Arthur, L. and Crossley, M. (2013) "Ethnographic Dazzle" and the Construction of the 'Other': Revisiting Dimensions of Insider and Outsider Research for International and Comparative Education, *Compare: A journal of Comparative and International Education*, 45(2): 295-316.

Melville, H. (1851) *Moby-Dick*, Richard Bentley, London.

Melzack, R. and Wall, P. (1996) Pain Mechanisms: A New Theory (Reprinted from Science, Vol 150 pg 971-979, 1965), *Pain Forum*, 5(1): 3-11.

Merchant, S. (2012) Negotiating Underwater Space: The Sensorium, the Body, and the Practice of Scuba Diving, *Tourist Studies*, 11(3): 215-234.

Merriman, P. (2007) *Driving Spaces: A Cultural-Historical Geography of England's M1 Motorway*, Blackwell, Oxford.

Merriman, P. (2006) Mirror, Signal, Manoeuvre: Assembling and Governing the Motorway Driver in Late Fifties Britain, *The Sociological Review*, 54(1): 75-92.

Merleau-Ponty, M. (2004) The World as Perceived, in Baldwin, T. (ed) *Maurice Merleau-Ponty: Basic Writings,* Routledge, London, 126-165.

Merleau-Ponty, M. (1962) *Phenomenology of Perception*, Routledge & Kegan Paul Ltd, London.

Merleau-Ponty, M. (1948) *Sens et non-sens*, Nagel, Paris.

Messinger, S. (2008) Anthropology and Its Individual, Social, and Cultural Contributions to Psychoprosthetics, in Gallagher, P., Desmon, D. and MacLachlan, M. (eds) *Psychoprosthetics*, Springer, London, 107-118.

Michael, M. (2000) These Boots are made for Walking…: Mundane Technology, the Body and Human-Environment Relations, *Body and Society,* 6(3-4): 107-126.

Miele, M. (2017) On Sensing and Making Sense, *Geoforum*, 82: 204-205.

Milligan, L. (2016) Insider-Outsider-Inbetweener? Researcher Positioning, Participative Methods and Cross-Cultural Education Research, *Compare: A journal of Comparative and International Education*, 46(2): 235-250.

Mindell, D. (2002) *Between Human and Machine: Feedback, Control, and Computing Before Cybernetics*, John Hopkins University Press, Baltimore.

Mol, A. (2002) *The Body Multiple: Ontology in Medical Practice*, Duke University Press, Durham, North Carolina.

Motagnini, L. (2013) Interdisciplinary Issues in Early Cybernetics, in Pléh, C., Ropolyi, L. and Gurova, L. (eds) *New Perspectives on the History of Cognitive Science*, Akadémiai Kiadó, Budapest, 81-90.

Montagnini, L., Tabacchi, M. and Termini, S. (2016) Out of A Creative Jumble of Ideas in the Middle of Last Century: Wiener, Interdisciplinarity and All That, *Biophysical Chemistry*, 208: 84-91.

Moody, L. (1993) The Mental and Physical Condition Known as the Yips, *Cricketer International* 74(2): 36-37.

Moran, D. (2000) *Introduction to Phenomenology,* Routledge, London.

Moran, D. and Disney, T. (2019) "It's a Horrible, Horrible Feeling": Ghosting and the Layered Geographies of Absent-Presence in the Prison Visiting Room, *Social and Cultural Geography,* 20(5): 692-709.

Murdock, J. (2006) *Post-structural Geography,* Sage, London.

Murray, C. (ed) (2010) *Amputation, Prosthesis Use, and Phantom Limb Pain: An Interdisciplinary Perspective*, Springer, London.

Murray, C. (2008) Embodiment and Prosthetics, in Gallagher, P., Desmond, D. and McLachlan, M. (eds) *Psychoprosthetics,* Springer, London, 119-129.

Murray, C. (2004) An Interpretative Phenomenological Analysis of the Embodiment of Artificial Limbs, *Disability Rehabilitation,* 26(16): 963-73.

Nagel, C. (2012) Phenomenology without 'the body'? *Studia Phaenomenologica,* 12: 17-33.

Nagel, T. (1974) What is it Like to be a Bat?, *The Philosophical Review*, 83(4): 435-450.

Needham, S. (2006) *Archery: The Art of Repetition*, Crowood Illustrated, Wiltshire.

Nietzsche, F. (1872) The Birth of Tragedy, E.W. Fritsch, Berlin.

Nikolajsen, L. and Jensen, T. (2001) Phantom Limb Pain, *British Journal of Anaesthesia,* 87(1): 107-116.

Nilsson, N. (2010) *The Quest for Artificial Intelligence: A History of Ideas and Achievements*, Cambridge University Press, New York.

Noble, G. and Watkins, M. (2003) So, How Did Bourdieu Learn to Play Tennis? Habitus, Consciousness and Habituation*, Cultural Studies*, 17(3-4): 520-539.

Ocejo, R. (2018) Untapped: Exploring the Cultural Dimensions of Craft Beer, *Contemporary Sociology: A Journal of Reviews*, 47(4): 436-438.

Ocejo, R. (2017) *Masters of Craft: Old Jobs in the New Urban Economy*, Princeton University Press, Princeton.

Pacault, M. and Patchett, M. (2018) The Last Plumassier: Storying Dead Birds, Gender and Paraffection at Maison Lemarié, *Cultural Geographies,* 25(1): 123-134.

Park, J. (2013) Arrow Behaviour in the Lateral Plane During and Immediately Following the Power Stroke of a Recurve Archery Bow, *Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology*, 227(3): 172-183).

Park, J. (2011) Arrow Behaviour in Free Flight*, Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology*, 225(4): 241-252Parry, B. (2017) The Social Life of "Scaffolds": Examining Human Rights in Regenerative Medicine, *Science, Technology, and Human Values,* 43(1): 95-120.

Parry, B. (2017) The Social Life of 'Scaffolds': Examining Human Rights in Regenerative Medicine*, Science, Technology and Human Values*, 43(1): 95-120.

Patchett, M. and Mann, J. (2018) Five Advantage of Skill, *Cultural Geographies*, 25(1): 23-29.

Paterson, M. (2009) Haptic geographies: ethnography, haptic knowledges and sensuous dispositions, *Progress in Human Geography,* 33(6): 766-788.

Paton, D. (2015) *The Quarry as Sculpture: the Place of Making*, Phd dissertation, Geography, College of Life and Environmental Sciences, Exeter.

Payne, E. (2018) The Craft of Musical Performance: Skilled Practice in Collaboration, *Cultural Geographies*, 25(1): 107-122.

Perrow, C. (1984) *Normal Accidents: Living With High-Risk Technologies*, Basic Books, New York.

Pervukhin, A. (2005) Deodands: A Study in the Creation of Common Law Rules*, The American Journal of Legal History,* 47(3): 237-256.

Pickering, A. (2010) *The Cybernetic Brain: Sketches of Another Future*, University of Chicago Press, Chicago.

Pietz, W. (1997) Death of the Deodand: Accursed Objects and the Money Value of Human Life, *Res: Anthropology and Aesthetics,* 31: 97-108

Pitt, H. (2015) On showing and being shown plants – a guide to methods for more-than-human geography, *Area,* 47(1): 48-55.

Polanyi, M. (1966) *The Tacit Dimension*, Routledge, London.

Polanyi, M. (198) *Personal Knowledge – Towards a Post-Critical Philosophy*, Routledge Kegan and Paul, London.

Potenza, A. (2017) Watch Astronaut Scott Kelly Struggle to Walk on Earth After a Year in Space, *The Verge*, last accessed 29th November 2020, <https://www.theverge.com/2017/10/28/16549898/scott-kelly-pbs-exclusive-clip-year-in-space-walking-problems-zero-gravity>

Price, L. and Hawkins, H. (2018) Geographies of Making, Craft and Creativity, Routledge, Oxon.

Prior, E. and Coates, J. (2020) Archers' Experiences of Target Panic: an Interpretative Phenomenological Analysis, *Qualitative Research in Sport, Exercise, and Health*, 12(2): 224-241.

Probyn, E. (2014) Women following fish in a more-than-human world, *Gender, Place, and Culture,* 21(5): 589-603.

Procee, H. (1997) Technology, Normativity, and the Future: The Aristotelian Turn, *Society for Philosophy and Technology Quarterly Electronic Journal,* 3(1): 19-26.

Proffitt, D., Stefanucci, J., Banton, T. and Epstein, W. (2003) The Role of Effort in Perceiving Distance, *Psychological Science,* 14(2): 106-112.

Quartarone, A., Siebner, H. and Rothwell, J. (2006) Task-Specific Hand Dystonia: Can Too Much Plasticity be Bad For You?, *Trends in Neuroscience,*29(4): 192-199.

Rammert, W. (2008) Where the Action Is: Distributed Agency Between Humans, Machines, and Programs, in Seifert, W., Kim, J. and Moore, A. (eds) *Paradoxes of Interactivity,* Bielefeld, London, 66-91.

Reason, P. (ed) (1994) *Participation in Human Inquiry*, Sage, London.

Reed-Danahay, D. (ed) (1997) *Auto/Ethnography: Rewriting the Social and the Self*, Berg, New York.

Reeves, B. and Nass, C. (1996) *The Media Equation: How People Treat Computers, Televisions and New Media Like Real People and Places*, Centre for the Study of Language and Information, Chicago.

Reno, J. Your trash is someone's treasure: the politics of value at a Michigan landfill, *Journal of Material Culture*, 14(1): 29-46.

Reynolds, J. (2019) The Meaning of Ability and Disability, *The Journal of Speculative Philosophy,* 33(3): 434-447.

Reynolds, J. (2017) Merleau-Ponty, world-creating blindness, and the phenomenology of non-normate bodies, *Chiasmi International*, 19: 419-34.

Rickly, J. (2016) The (Re)Production of Climbing Space: Bodies, Gestures, Texts, *Cultural Geographies*, 24(1): 69-88.

Rid, T. (2016) *Rise of the Machines: A Cybernetic History*, W.W. Norton, London.

Roberts, T. (2019) Resituating Post-Phenomenological Geographies: Deleuze, Relations and the Limits of Objects, *Transactions of the Institute of British Geographers* 44(3): 542-554.

Rogers, L. and Swadener, B. (1999) Reframing the 'Field', *Anthropology and Education Quarterly,* 30(4): 436-440.

Rose, G. (1997) Situating Knowledges: Positionality, Reflexivity and Other Tactics, *Progress in Human Geography,* 21(3): 305-320.

Rose, M. (2010) Back to Back: A Response to 'Landscape, Absence and the Geographies of Love,' *Transactions of the Institute of British Geographers,* 35(1): 141-144.

Rosenberger, R. (2015) Postphenomenology: What's New? What's Next?, in Friis, J and Crease, R (eds) *Technoscience and Postphenomenology: The Manhattan Papers*, Lexington Books, London, 129-148.

Rosenberger, R. (2014) Multistability and the Agency of Mundane Artifacts: from Speed Bumps to Subway Benches, *Human Studies*, 37: 369-392.

Rosenberger, R. (2008) Perceiving Other Planets; Bodily Experience, Interpretation, and The Mars Orbiter Camera, *Human Studies*, 31(1): 63-75.

Rosenberger, R. and Verbeek, P. (eds) (2015) *Postphenomenological Investigations: Essays on Human-Technology Relations*, Lexington Books, London.

Rosenblueth, A., Wiener, N. and Bigelow (1943) Behaviour, Purpose and Teleology, *Philosophy of Science,* 10: 18-24.

Rosetto, T. (2018) Repeat Photography, Post-Phenomenology and 'Being-With' Through the Image (at the First World War Cemeteries of Asiago, Italy), *Transactions of the Institute of British Geographers,* 44(1): 125-140.

Rossiter, P. (2007) Rock Climbing: On Humans, Nature, and Other Nonhumans, *Space and Culture,* 10(2): 292-305.

Sachdev, P. (1992) Golfers' Cramp: Clinical Characteristics and Evidence Against it Being an Anxiety Disorder, *Movement Disorders: Official Journal of the Movement Disorder Society*, 7(4): 326-332.

Sage, D., Dainty, A., Tryggestad, K., Justesen, L. and Mouritsen, J. (2014) Building *with* Wildlife: Project Geographies and Cosmopolitics in Infrastructure Construction, *Construction Management and Economics*, 32(7-8): 773-786.

Salen, K. and Zimmerman, E. (2003) *Rules of Play: Game Design Fundamentals*, MIT Press, Cambridge.

Sartre, J. (1956) *Being and Nothingness: An Essay on Phenomenological Ontology,* translated by Barnes, H, Philosophical Library, New York.

Sartre, J. (1943) *L'Être et le Néant,* Éditions Gallimard*,* Paris.

Scarry, E. (1985) *The Body in Pain: The Making and Unmaking of the World*, Oxford University Press, Oxford.

Schulze-Makuch, D. and Irwin, L. (2018) *Life in the Universe: Expectations and Constraints,* Springer, Berlin.

Schensul, S., Schensul, J. and LeCompte, M. (1999) *Essential Ethnographic Methods*¸ Alta Mira Press, Walnut Creek, California.

Schiellerup, P. (2008) Stop Making Sense: The Trial and Tribulations of Qualitative Data Analysis, *Area*, 40(2): 163-171.

Scholl, J. (2015) Putting phenomenology in its place: some limits of a phenomenology of medicine, *Theoretical Medicine and Bioethics*, 36: 391-410.

Sennett, R. (2008) *The Craftsman,* Allen Lane, London.

Serres, M. (1982) Genese, Éditions Grasset, Paris.

Serres, M. (1980) *Hermès V, Le passage du Nord-ouest*, Éditions de Minuit, Paris

Serres, M. (1969) *Mermes I, la Communication*, Editions de Minuit, Paris.

Serres, M. and Schehr, L. (1983) Noise, *SubStance*, 12(3): 44-60.

Sexton, A., Hayes-Conroy, A., Sweet, E., Miele, M. and Ash, J. (2017) Better Then Text? Critical Reflections on the Practices of Visceral Methodologies in Human Geography*, Geoforum*, 1(82): 200-201.

Shannon, C. (1948) A Mathematical Theory of Communication, *Bell System Technical Journal*, 27: 379-423 and 623-656.

Shannon, C. and Weaver, W. (1963) *The Mathematical Theory of Communication*, University of Illinois Press, Illinois.

Shea, J. (2006) The Origins of Lithic Projectile Point Technology: Evidence from Africa, the Levant, and Europe, *Journal of Archaeological Science,* 33(6): 823-846.

Shea, J. and Sisk, M. (2010) Complex Projectile Technology and Homo Sapiens Dispersal into Western Eurasia, *PaleoAnthroplogy*, 2010: 100-122.

Sheller, M. and Urry, J. (2004) *Tourism Mobilities: Places to Play, Places in Play*, Routledge, London.

Shrestha, P. (2017) Motivation Emotion: Yerkes – Dodson Law, *Psychestudy*, last accessed 21st December 2020, <https://www.psychestudy.com/general/motivation-emotion/yerkes-dodson-law>

Shove, E. and Southerton, D. (2000) Defrosting the Freezer: From Novelty to Convenience: A Narrative of Normalization, *Journal of Material Culture*, 5(3): 301-319.

Simon, S. and Randalls, S. (2016) Geography, Ontological Politics and the Resilient Future, *Dialogues in Human Geography,* 6(1): 3-18.

Simpson, P. (2017) Sonic Affects and the Production of Space: 'Music by Handle' and the Politics of Street Music in Victorian London¸ *Cultural Geographies*, 24(1): 89-109.

Simpson, P. (2013) Ecologies of Experience: Materiality, Sociality, and the Embodied Experience of (Street) Performing, *Environment and Planning A*, 45(1): 180-196.

Simpson, P. (2009) 'Falling on Deaf Ears': A Post-Phenomenology of Sonorous Presence, *Environment and Planning A*, 41(11): 2556-2575.

Smith, A. (2003) Do You Believe in Ethics? Latour and Ihde in the Trenches of the Sciences Wars (Or: Watch Out Latour, Ihde's Got a Gun), in Ihde, D. and Selinger, E. (eds) *Chasing Technoscience: Matrix for Materiality*, Indiana University Press, Bloomington.

Smith, A., Adler, D., Crews, R., Wharen, E., Laskowsk, K., Barnes, K., Bell, C., Pelz, D., Brennan, R., Smith, J., Sorenson, M and Kaufman, K. (2003) The 'Yips' in Golf, *Sports Medicine*, 33(1): 13-31.

Smith, R. (2008) Pain in the Act: the Meaning of Pain Among Professional Wrestlers, *Qualitative Sociology*, 36; 129-148.

Sobchack, V. (2010) Living a 'Phantom Limb': On the Phenomenology of Bodily Integrity*, Body and Society*, 16(3): 51-67.

Southerton, D. (2003) 'Squeezing Time': Allocating Practices, Coordinating Networks and Scheduling Society*, Time and Society*, 12(1): 5-25.

Spencer, D. (2013) Sensing violence: An ethnography of mixed martial arts. *Ethnography,* 15(2): 232-254.

Spencer, D. (2012) Narratives of despair and loss: pain, injury and masculinity in the sport of mixed martial arts, *Qualitative Research in Sport, Exercise and Health,* 4(1): 117-137.

Spencer, D. (2009) Habit(us), Body Techniques and Body Callusing: An Ethnography of Mixed Martial Arts, *Body and Society*, 15(4): 119-143.

Spinney, J. (2006) A Place of Sense: A Kinaesthetic Ethnography of Cyclists on Mont Ventoux, *Environment and Planning D: Society and Space*, 24(5): 709-732.

Spinosa, C., Flores, F., and Dreyfus, H. (1999) *Disclosing New Worlds: Entrepreneurship, Democratic Action, and the Cultivation of Solidarity*, MIT Press, Boston.

Stanko, E. (1995) Women, crime and fear, *Annals of the American Association of Political and Social Science,* 539: 46-58.

Stanton, N. (2014) Representing Distributed Cognition in a Complex System: How a Submarine Returns to Periscope Depth, *Ergonomics,* 57)3): 403-418.

Starks, H. and Trinidad, S. (2007) Choose Your Method: A Comparison of Phenomenology, Discourse Analysis and Grounded Theory*, Qualitative Health Research* 17(10): 1372-1380.

Stephens, N. and Delamont, S. (2013) 'I can See it in the Nightclub': Dance, Capoeira and Male Bodies, *The Socialogical Review,* 62(1): 149-166.

Sternard, D. (2018) It's Not (Only) the Mean that Matters: Variability, Noise and Exploration in Skill Learning, *Current Opinion in Behavioural Sciences*, 20: 183-195.

Sternad, D., Huber, M. and Kuznetsov, N. (2014) Acquisition of Novel and Complex Moto Skills: Stable Solutions Where Intrinsic Noise Matters Less, *Advanced Experiments in Medical Biology*, 826: 101-124.

Stewart, J. (1790) *The Revolution of Reason: Or the Establishment of the Constitution of Things in Nature, of Man, of Human Intellect, of Moral Truth, or Universal Good*, J. Ridgeway, London.

Stewart, K. (2011) Atmospheric Attunements, *Environment and Planning D: Society and Space,* 29(3): 445-453.

Strathern, M. (1987) The Limits of Auto-Anthropology, in Jackson, A. (ed) *Anthropology at Home*, Tavistock Publications, London 59-67.

Straughan, E. (2018) Entangled corporeality in the making of taxidermy, in Hawkins, H. and Price, L. (eds) *Geographies of Making, Craft and Creativity,* Oxon, Routledge, 144-157.

Straughan, E. (2015) 'Entangled corporeality: Taxidermy practice and the vibrancy of dead matter, *GeoHumanities,* 1(2): 363-377.

Sudnow, D. (1978) *Ways of the Hand*, Harvard University Press, Cambridge.

Sutton, J. (2007) Batting, habit and memory: The embodied mind and the nature of skill, *Sport in Society,* 10(5): 763-786.

Swan, M. (2012) Health 2050: The Realization of Personalized Medicine Through Crowdsourcing, the Quantified Self, and the Participatory Biocitizen, *Journal of Personalized Medicine,* 2(3): 93-118.

Swan, M. (2009) Emerging Patient-Driven Health Care Models: An Examination of Health Social Networks, Consumer Personalized Medicine and Quantified Self-Tracking, *international Journal of Environmental Research and Public Health,* 6(2): 492-525.

Sweet, E. (2017) The Benefits and Challenges of Collective and Creative Storytelling Through Visceral Methods Within the Neoliberal University, *Geoforum*, 82: 202-203.

Sweet, R. (2016) *Prosthetic Body Parts in Literature and Culture, 1832-1908*, PhD dissertation, English, College of Humanities, University of Exeter, UK.

Swyngedouw, E. (2006) Circulation and Metabolisms: (Hybrid) Natures and (Cyborg) Cities, *Science as Culture*, 15(2): 105-121.

Taylor, T. (2010) *The Artificial Ape: How Technology Changed the Course of Human Evolution,* Palgrave Macmillan, New York.

Telakivi, P. (2020) *Extending the Extended Mind: From Cognition to Consciousness*, PhD dissertation, Philosophy, Arts and Society, Faculty of Arts, University of Helsinki, Finland.

Thaler, R. and Sunstein, C. (2008) *Nudge: Improving Decisions About Health, Wealth, and Happiness*, Yale University Press, New Haven.

Thaler, R., Sunstein, C. and Balz, J. (2013) Choice Architecture, in Shafir, E. (ed) *The Behavioural Foundations of Public Policy*, Princeton University Press, New Jersey, 245-263.

Thomas, K. (2008) The Secret Curse of Expert Archers, *New York Times*, access 28th November 2020, <https://www.nytimes.com/2008/08/01/sports/olympics/01archery.html>

Thomas, S. and Pollio, H. (2002) *Listening to Patients: A Phenomenological Approach to Nursing Research and Practice*, Springer, New York.

Thorpe, A. (2014) Doing the Right Thing or Doing the Thing Right: Implications of Participant Withdrawal, *Organizational Research Methods*, 17(3): 255-277.

Thrift, N. (2008) *Non-Representational Theory: Space, Politics, Affect*, Routledge, London.

Thrift, N. (2000) Still Life in Nearly Present Time; The Object of Nature*, Body and Society*, 6(3-4): 34-57.

Thrift, N. (1999) Steps to an Ecology of Place, in Massey, D., Allen, J. and Sarre, P. (eds) *Human Geography Today*, Polity Press, Cambridge, 295-323.

Thrift, N. and Dewsbury, J. (2000) Dead Geographies – and How to Make Them Live, *Environment and Planning D: Society and Space*, 18(4): 411-432.

Thorndahl, K. and Ravn, S. (2016) Expert Tool Use: A Phenomenological Analysis of Processes of Incorporation in the Case of Elite Rope Skipping, *Sport Ethics and Philosophy*, 10(3): 310-324.

Till, K. (2001) Returning Home and to the Field, *The Geographical Review*, 91(1-2): 46-56.

Tillmann-Healy, L. (2003) Friendship as a Method, *Qualitative Inquiry*, 9(5): 729-749.

Tillmann-Healy, L (2001) *Between Gay and Straight: Understanding Friendship Across Sexual Orientation*, Alta Mira Press, Walnut Creek, California.

Toombs, K. (1992) The lived experience of disability, *Human Studies* 18: 9-23

Trentmann, F. (2009) Disruption is Normal: Blackouts, Breakdowns and the Elasticity of Everyday Life, in Shove, E., Trentmann, F. and Wilk, R. (eds) *Time, Consumption and Everyday Life: Practice, Materiality and Culture,* Berg, Oxford, 67-84.

Tribus, M. and McIrvine, E. (1971) Energy and Information, *Scientific American*, 224, 179-188

Tsakiris, M. (2010) *My* Body in the Brain: A Neurocognitive Model of Body-Ownership, *Neuropsychologia,* 48(3): 703-712.

University of Exeter (2018) *Presentation of Thesis/Dissertations for Degrees in the Faculty of Graduate Research: Statement of Procedures*, last accessed 27th November 2020, <http://as.exeter.ac.uk/academic-policy-standards/tqa-manual/pgr/presentationoftheses/>

Urbanik, J. (2012) *Placing Animals: An Introduction to the Geography of Human-Animal Relations*, Rowman and Littlefield Publishers, London.

Valentine, G. (2005) Tell Me About…: Using Interviews as a Research Method, in Flowerdew, R. and Martin, D. (eds) *Methods in Human Geography: A Guide for Students*, Pearson Education Ltd, London 110-127.

Valentine, G. (1989) The geographies of women's fear, *Area,* 21(4): 385-390.

Vallée, R. (2003) History of Cybernetics, *Systems Science and Cybernetics*, 3: n.p.

Van Hinte, E. (1997) *Eternally Yours: Visions on Product Endurance*, 010 publishers Rotterdam.

Vannini, P. (2015) Non-Representational Ethnography: New Ways of Animating Lifeworlds, *Cultural Geographies*, 22(2): 317-327.

Verbeek, P. (2016) Toward a Theory of Technological Mediation: A Program for Postphenomenological Research in Friis, J and Crease, R (eds) *Technoscience and Postphenomenology: The Manhattan Papers*, Lexington Books, London, 129-148.

Verbeek, P. (2008) Obstetric Ultrasound and the Technological Mediation of Morality: A Postphenomenological Analysis, *Human Studies,* 31(11): 11-26.

Verbeek. P. (2005) *What Things Do: Philosophical Reflections on Technology, Agency, and Design*, Penn State University Press, Pennsylvania.

Vidich, A. and Bensman, J. (1958) Freedmon and Responsibility in Research, *Human Organization,* 17(2): 1-2

von Foerster, H. (2003) *Understanding: Essays on Cybernetics and Cognition*, Springer-Verlag, New York.

von Foerster, H. (ed) (1974) *Cybernetics of Cybernetics: Or, the Control of Control and the Communication of Communication*, Future Systems, Minneapolis.

von Foerster, H. (1958) Basic Concepts of Homeostasis *Brookhaven Symposia in Biology,* 10: 216.

von Foerster, H. (ed) (1949) *Cybernetics: Transactions of the Sixth Conference*, Josiah Macy Jr Foundation, New York

von Neumann, J. (1948) The General and Logical Theory of Automata, in Jeffress, L. (ed) *Cerebral Mechanisms in Behaviour: The Hixon Symposium*, John Wiley and Sons, New York.

Vosters, H. (2014) Military Memorialization and its Object(s) of Period Purification, in Schweitzer, M. and Zerdy, J. (eds) *Performing Objects and Theatrical Things*, Palgrave Mcmillan, Basingstoke.

Wacquant, L. (2011) Habitus as topic and tool: reflections on becoming a prizefighter, *Qualitative Research in Psychology,* 8(1): 81-92.

Wacquant, L. (2004) *Body and Soul: Ethnographic Notebooks of An Apprentice-Boxer*, Oxford University Press, New York.

Wacquant, L. (1995) The pugilistic point of view: How boxers think and feel about their trade, *Theory and Society*, 24(4): 489-535.

Waldenfels, B. (2004) Bodily Experience Between Selfhood and Otherness, *Phenomenology and Cognitive Sciences,* 3: 235-248.

Wall, S. (2008) Easier said than done: writing an autoethnography, *International Journal of Qualitative Methods*, 7(1): 38-53.

Walter, W. (1953) *The Living Brain,* Duckworth, London.

Warfield, K. (2016) Making the Cut: An Agential Realsit Examination of Selfies and Touch, *Social Media + Society*, 2(2): 1-10

Waytz, A., Morewedge, C., Epley, N., Monteleone, G., Gao, J. and Cacioppo, J. (2010) Making Sense by Making Sentient: Effectance Motivation Increases Anthropomorphism, *Journal of Personality and Social Psychology*, 99(3): 410-435.

Weiss, R. (1998) A Taxonomy of Relationships, *Journal of Social and Personal Relationships*, 15: 671-683.

Weiss, T. Miltner, W., and Adler, T., Bruckner, L. and Taub, E. (1999) Decrease in Phantom Limb Pain Associated with Prosthesis-Induced Increased Use of an Amputation Stump in Humans, *Neuroscience Letters*, 72(2): 131-134.

Whatmore, S. (2002) *Hybrid Geographies: Natures, Cultures, Spaces,* Sage, London.

White, A. (1989) Confessions of a Frozen Zoologist, *Australian Zoologist,* 25(3): 95-98.

White, J. (1993) Yikes it's Golfers Yips, *Physician and Sports Medicine,* 21: 13-14.

Wiener (1954) *The Human Use of Human Beings* (2nd edition), Eyre and Spottiswoode, London.

Wiener, N. (1950) *The Human Use of Human Beings*, Eyre and Spottiswoode, London.

Wiener, N. (1948) *Cybernetics: or Control and Communication in the Animal and the Machine*, MIT Press, Cambridge.

Wiener, N. (1947) A Scientist Rebels, a letter in *Atlantic Monthly*, January.

Wilk, J., 1993. *The Art of the Nudge: Minimalist Intervention and the Science of Change,* invited Address to the Strategic Planning Society.

Wills, D. (1995) *Prosthesis*, Stanford University Press, Redwood City.

Wilson, M. (2011) 'Training the Eye': Formation of the Geocoding Subject, *Social and Cultural Geography*, 12(4): 357-376.

Windschitl, P., Kruger, J., and Simms, E. (2003) The Influence of Egocentrism and Focalism on People's Optimism in Competitions: When What Affects Us Equally Affects Me More*, Journal of Personality and Social Psychology*, 85(3): 389-408

Witt, J., Proffitt, D. and Epstein, W. (2005) Tool Use Affects Perceived Distance, But Only When You Intend To Use It*, Journal of Experimental Psychology: Human Perception and Performance*, 31(5): 880-888

Witt, J., Proffitt, D. and Epstein, W. (2004) Perceiving Distance: A Role of Effort and Intent, *Perception*, 33: 577-590.

Wolcott, H. (2001) *Writing up Qualitative Research*, London, Sage.

Wolff, S. (2004) Ways into the Field and Their Variants, in Flick, U., von Kardoff, E. and Ines, S. (eds) *A Companion TO Qualitative Research*, Sage, London, 195-202.

Wood, D., Bruner, J. and Ross, G. (1976) The Role of Tutoring in Problem Solving, *Journal of Child Psychology and Psychiatry,* 17(2): 89-100.

World Archery (2020) *Rulebook*, last accessed 28th November 2020 <https://worldarchery.org/rulebook>

World Archery (2006) *History of Archery*, last accessed 23rd November 2020 <https://worldarchery.org/History-Archery>

World Material (2020) *Wight and Density of Stainless Steel*, last accessed 29th November 2020 <https://www.theworldmaterial.com/weight-density-of-stainless-steel/>

Wylie, J. (2009) Landscape, Absence and the Geographies of Love, *Transactions of the Institute of British Geographers*, 34(3): 275-289.

Wylie, J. (2007) The Spectral Geographies of W.G. Sebald, *Cultural Geographies,* 14(2): 171-188.

Wylie, J. (2006) Depths and Folds: On Landscape and the Gazing Subject, *Environment and Planning D: Society and Space,* 24(4): 519-535.

Wylie, J. (2005) A Single Day's Walking: Narrating Self and Landscape on the South West Coast Path, *Transactions of the Institute of British Geographers*, 30(2) 234-247.

Yerkes, R, and Dodson, J. (1908) The Relation of Strength of Stimulus to Rapidity of Habit-Formation, *Journal of Comparative Neurology and Psychology*, 18: 459-482.

Young, I. (1980) Throwing like a girl: A phenomenology of feminine body comportment motility and spatiality, *Human Studies*, 3: 137-156.

Young, J. (1969) *Cybernetics*, Iliffe Ltd, London.

Zhang, V. (2020) Noisy Field Exposures, or What Comes Before Attunement*, Cultural Geographies*, 27(4): 647-664.

Zwier, J., Blok, V. and Lemmens, P. (2016) Phenomenology and the empirical turn: a phenomenological analysis of postphenomenology, *Philosophy and Technology,* 29: 1-21

Zylinska, J. (ed) (2002) *The Cyborg Experiments: The Extensions of the Body in the Media Age*, Continuum, London.

Appendices

Appendix One: Ethnography consent form

College of Life and Environmenta
Sciences.
360 Amory Building
Rennes Drive
Exeter
EX4 4RJ
w www.exeter.ac.uk

University of Exeter Archery Club

Informed consent form for the undertaking of ethnographic research within the University of Exeter Archery Club.

Members of the Committee,

This Informed Consent Form has two parts:

- Information Sheet (to provide an overview of the study's purpose and methodology)
- Certificate of Consent (to be signed should you choose to participate)

You will be given a copy of the full Informed Consent Form for your own records.

Section 1: Information Sheet

Introduction
I am a postgraduate research student in the Geography department of the University of Exeter. I am currently undertaking research on the relationship between people and objects, and how this relationship develops and transforms as individuals becomes skilled in the use of those objects. This project is being supervised by Professor John Wylie and Doctor Jennifer Lea. I would like to invite you, as a club, to participate in this study; this sheet provides information about what the project does and what your role would be if you chose to participate. If you have any questions about the project before making a decision please do contact me via email (**er316@exeter.ac.uk**) or in person. If you choose to participate and have any questions during the study I would be happy to answer these too, and they can be directed to be via email as well.

Purpose of the Research
The use of technology is an increasingly important part of everyday life. Using this study, I want to understand what it means to become skilled in the use of such technologies. I have chosen archery as a site in which to begin this investigation because I believe that the sport explicitly foregrounds training individuals to develop skilled use of a technology (the bow). I want to look at how we can train people to use technologies, and what characteristics of a relationship with a specific technology and associated with skilled use.

Types of Research Intervention
This research will be carried out in two streams which will occur simultaneously. One of these will take the form of interview series. These will be carried out with individual participants who will be asked to provide separate consent. ***This form requests your consent to seek participants from within the club for the interview stage.*** The other stream will be an ethnographic study of archery as a practice. During this stream I would be attending all of the club's sessions as a regular member, but would be making notes about events and occurrences in addition to my own training. This may require me to ask non-invasive questions of other members which would involve them reflecting on what they are doing(e.g. "why are you approaching that in that particular way?"). All notes made on observations will be stored securely and names will be replaced with pseudonyms. To ensure that all participants are full aware of the study I request that, as part of this agreement, I have the opportunity to provide an overview of the project (similar

that provided here) to the members of the club during the first two weeks of the academic year 2017/18. ***This form requests your consent for the ethnographic fieldwork to be undertaken in its entirety.***

Duration
The research will take place over the course of roughly a year. The ethnographic stream will commence and end with the academic year: 18th September 2017 – 15th June 2018. The interview process will extend beyond this and would start immediately and would be expected to end before 1st January 2019.

Confidentiality
Any observations which include an individual's name will have that name replaced with a pseudonym. All digitally stored data will be secured by a password and will not be accessible, in its raw form, by anyone other than me. Anonymised data will likely feature in the final project, this may take the form of brief quotes attributed to pseudonyms or descriptions of events which cannot be used to identify specific individuals. Knowledge generated through this study will potentially become publically accessible through publication.

Sharing the Results
Nothing said during the study will be attributed to any member of the club by name. The knowledge gained from this research will be shared with the club as far as is appropriate and so long as it does not infringe upon the privacy of participants or the integrity of the project itself. Results may also be shared more broadly, through publications and conferences.

Right to Withdraw
Participants will have the option of withdrawing from the study at any point by completing an opt-out form, this form is to be completed by the individual and should it be filled in all data regarding them will be removed from the study and no further observations including them will be made. This form can be filled in at any point from the beginning of the study to 1st August 2018.

Who to Contact
Any questions regarding the study can be directed to me, either in person or by email (**er316@exeter.ac.uk**).

This proposal has be reviewed and approved by the Geography Ethics Committee as being in line with the University of Exeter Ethics Framework.

Section 2: Certificate of Consent

I have been invited to participate in a research about training to use a technological object (the bow). I have also been asked to provide consent on behalf of the club for observations to be made during training sessions and other club-related activities.

I have been informed that all names will be substituted for pseudonyms and understand that the study itself may end up as publically accessible through publications and conference material.

I have been instructed that should an individual, including myself, wish to withdraw from this study they must sign an opt-out form and submit it to Eliott Rooke in person or by email (er316@exeter.ac.uk) **before 1st August 2018.**

I accept that, in the interest of providing the members of the club with the ability to make an informed decision as to whether to participate, the researcher (Eliott Rooke) will require an opportunity to address the members of the club **by 9th October 2017** in order to convey information in a similar manner to with Section 1 of this form.

I have read the foregoing information and have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study and further consent, as a member of the University of Exeter Archer Club Committee, for this study to be undertaken within the club for the period agreed.

[redacted] (Captain) _____ (signature) _____ (DD/MM/YYYY)

[redacted] (Secretary) _____ _____

[redacted] (Treasurer) _____ _____

[redacted] (SCO) _____ _____

[redacted] (Equipment Officer) _____ _____

[redacted] (Equipment Officer) _____ _____

[redacted] (Social Secretary) _____ _____

Appendix Two: Interview consent form

College of Life and Environmental Sciences.
360 Amory Building
Rennes Drive
Exeter
EX4 4RJ
w www.exeter.ac.uk

Informed consent form for participation in an interview series.

This Informed Consent Form has two parts:

- Information Sheet (to provide an overview of the study's purpose and methodology)
- Certificate of Consent (to be signed should you choose to participate)

You will be given a copy of the full Informed Consent Form for your own records.

Section 1: Information Sheet

Introduction
I am a postgraduate research student in the Geography department of the University of Exeter. I am currently undertaking research on the relationship between people and objects, and how this relationship develops and transforms as individuals becomes skilled in the use of those objects. This project is being supervised by Professor John Wylie and Doctor Jennifer Lea. I would like to invite you to participate in this study; this sheet provides information about what the project does and what your role would be if you chose to participate. If you have any questions about the project before making a decision please do contact me via email (**er316@exeter.ac.uk**) or in person. If you choose to participate and have any questions during the study I would be happy to answer these too, and they can be directed to be via email as well.

Purpose of the Research
The use of technology is an increasingly important part of everyday life. Using this study, I want to understand what it means to become skilled in the use of such technologies. I have chosen archery as a site in which to begin this investigation because I believe that the sport explicitly foregrounds training individuals to develop skilled use of a technology (the bow). I want to look at how we can train people to use technologies, and what characteristics of a relationship with a specific technology and associated with skilled use.

Types of Research Intervention
This research will be carried out in two streams which will occur simultaneously. One of these will be an ethnographic study of archery as a practice. The other will take the form of interview series. ***This form requests your consent to participate in the interview process.***

Duration
Individual interviews are expected to last about an hour. The number of interviews will vary from person to person but participants may choose not to participate in further interviews at any point, without needing to withdraw from the study entirely.

Confidentiality
Any observations which include an individual's name will have that name replaced with a pseudonym. The interviews will be recorded for later transcription. These recording will be deleted at the end of the project. All digitally stored data will be secured by a password and will not be accessible, in its raw form, by

anyone other than me. Anonymised data will likely feature in the final project, this may take the form of brief quotes attributed to pseudonyms or descriptions of events which cannot be used to identify specific individuals. Knowledge generated through this study will potentially become publically accessible through publication.

Sharing the Results
Nothing said during the study will be attributed to any participant by name. The knowledge gained from this research will be shared with the University of Exeter Archery Club as far as is appropriate and so long as it does not infringe upon the privacy of participants or the integrity of the project itself. Results may also be shared more broadly, through publications and conferences.

Right to Withdraw
Participants will have the option of withdrawing from the study at any point by completing an opt-out form, this form is to be completed by the individual and should it be filled in all data regarding them will be removed from the study and no further observations including them will be made. This form can be filled in at any point from the beginning of the study to 1st August 2018.

Who to Contact
Any questions regarding the study can be directed to me, either in person or by email (**er316@exeter.ac.uk**).

This proposal has be reviewed and approved by the Geography Ethics Committee as being in line with the University of Exeter Ethics Framework.

Section 2: Certificate of Consent

I have been invited to participate in a research about training to use a technological object (the bow). I have also been asked to provide consent to be interviewed.

I have been informed that all names will be substituted for pseudonyms and understand that the study itself may end up as publically accessible through publications and conference material.

I have been instructed that should I wish to withdraw from this study they must sign an opt-out form and submit it to Eliott Rooke in person or by email (er316@exeter.ac.uk) **before 1st August 2018.**

I have been informed that the interviews will be recorded for later transcription.

I have read the foregoing information and have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study.

Print Name: _____

Sign Name: _____

Date: _____

Appendix Three: Confirmation of ethical approval

Ethical Approval system

This is to inform you that the application (2017/1551)
by Eliott Rooke
Entitled
Exploring the Transformative Propensities of Prosthetics in Martial Arts Practice
has been accepted

Dear Eliott Rooke,

Application ID: **eCLESGeo000038 v2.1**
Title: **Taking object design beyond functionality**

Your e-Ethics application has been reviewed by the CLES – Geography Ethics Committee.

The outcome of the decision is: **Favourable**

Potential Outcomes

Favourable:	The application has been granted ethical approval by the Committee. The application will be flagged as Closed in the system. To view it again, please select the tick box: View completed
Favourable, with conditions:	The application has been granted ethical approval by the Committee under the provision of certain conditions.
Provisional:	You have **not** been granted ethical approval. The application needs to be amended in light of the Committee's comments and re-submitted for Ethical review.
Unfavourable:	You have **not** been granted ethical approval. The application has been **rejected** by the Committee. The application needs to be amended in light of the Committee's comments and resubmitted / or you need to complete a new application.

Please log back into the e-ethics system to view your application and respond to comments as required. If you cannot see it listed under your current applications tab, please tick the 'view completed' box.

If you have any queries about accessing the E-Ethics system please contact SID. If you have any further questions about the content of the decision, please talk to your research supervisor or Geography Exeter Ethics Chair.

Kind regards,
Geography Exeter Ethics Committee

Appendix Four: Opt-out form

College of Life and Environmental Sciences.
360 Amory Building
Rennes Drive
Exeter
EX4 4RJ
w www.exeter.ac.uk

Opt-out form

I have freely chosen to withdraw from this study and request that all data pertaining to me is destroyed or returned. I understand that, should publications already be in print, this may not be possible. I further understand that events within which I was a participant may still be used so long as no reference to me as an individual is made.

I have chosen to withdraw from this study because (optional):

Print Name: _____

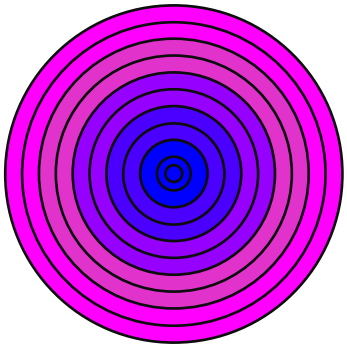
Sign Name: _____

Date: _____

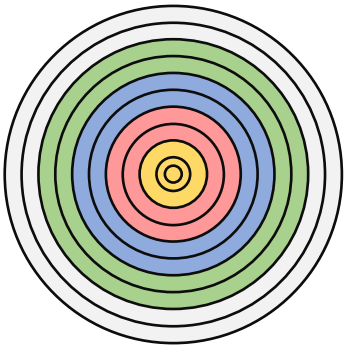
This form must be returned to Eliott Rooke in person or by email (er316@exeter.ac.uk) prior to August 1st 2018. Any forms returned on or after this date cannot be accepted.

Appendix Five: Sample target designs

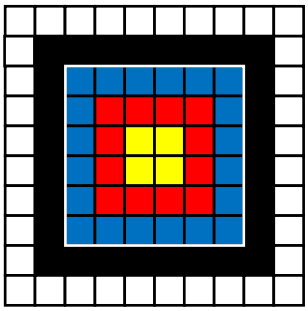
1



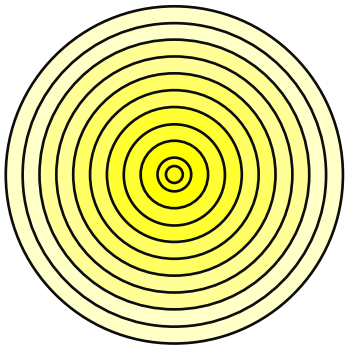
2



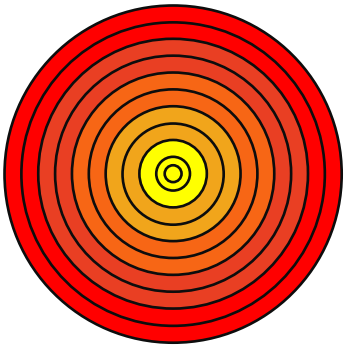
3



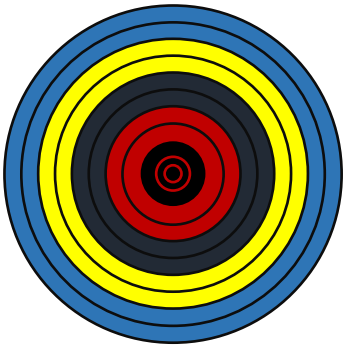
4



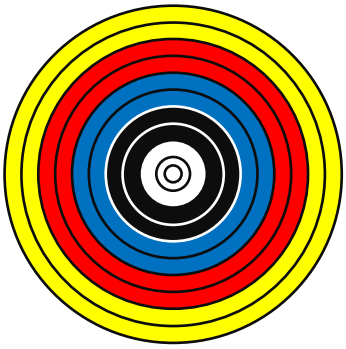
5



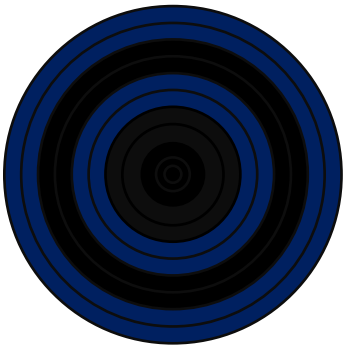
6



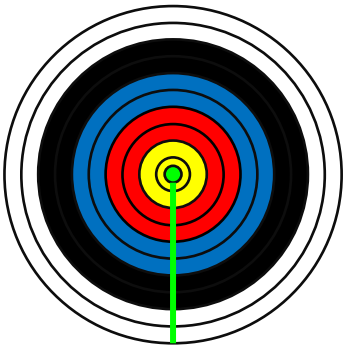
7



8

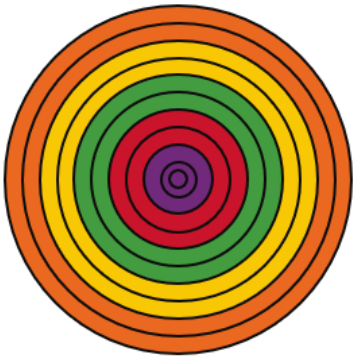


9

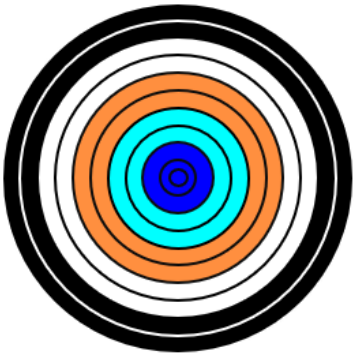


1. A high contrast target which maintains the vividness of a usual target face but sticks to the blue spectrum and avoids yellows.
2. A low contrast pastel-inspired target which has a less vibrant appearance.
3. This target uses a grid of squares to avoid the focusing imperative of concentric shapes. This target is for five-zone scoring (9,7,5,3,1) and each side should be approximately 88.5% of the diameter of the equivalent circular target face (e.g. 53.2cm for a 60cm face).
4. A gentle fade into the gold centre blurs the boundaries between gold/non-gold to help gold-shy archers re-acclimatise.
5. Following the same principle as Target 4, this target uses red as the outer colour to replicate the red/gold divide of a standard target but extrapolate across the whole target face.
6. A high contrast, block-coloured target where the gold ring is present but not at the centre of the target.
7. A standard target with the colours inverted.
8. A standard target overlaid with a blue filter.
9. A standard target face with a fluorescent sight pin drawn on to partially simulate the image seen through a scope.

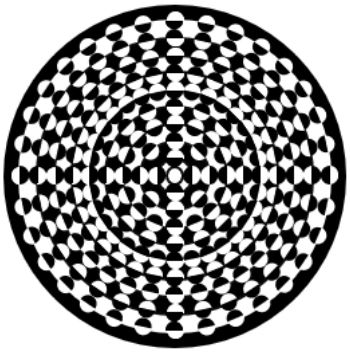
10



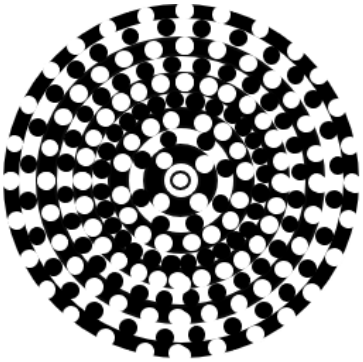
11



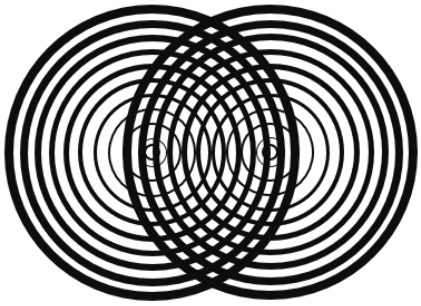
12



13

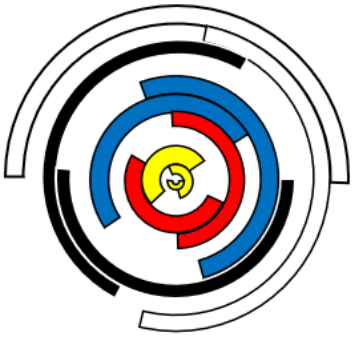


14



15

16



While targets 1-9 served specific purposes, targets 10-16 are more experimental and artistic. While they could have benefits for archers these would predominantly occur as a result of not being the traditional colour and format.

10. Alternative colour target.
11. High contrast target
12. Optical illusion version 1
13. Optical illusion version 2
14. Optical illusion version 3
15. Pop-art inspired triple-spot
16. Splintered target