

DOCTOR OF PHILOSOPHY

Re/contextualization on the critical appropriation of technologies as artistic practice

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Award date:
2019

Awarding institution:
Coventry University

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Re/contextualization:

**On the critical appropriation of
technologies as artistic practice**

By

Teoma J. Naccarato

January 2019



**A thesis submitted in partial fulfilment of the University's requirements for
the Degree of Doctor of Philosophy**

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Certificate of Ethical Approval

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Real-time Negotiations with the Heart:
Towards a Relational Framework for Interactive Performance

This is to certify that the above named applicant has completed the Coventry University Ethical Approval process and their project has been confirmed and approved as Medium Risk

Date of approval:

19 December 2016

Project Reference Number:

P46584

Abstract

Is it possible to design, or to choreograph and compose, without assuming *a priori* differences between ‘things that interact’? In the context of dance and music these ‘things’ might include bodies, movements, gestures, and sounds, as well as streams of data from motion-capture or physiological sensors. Thinking more broadly, these ‘things that interact’ might include entire disciplines and cultures. As a choreographer, I appropriate technologies such as heart rate sensors (ECGs) and use them in the process of shaping contexts in which dancers, musicians, and audience-participants *interact*. In so doing, I have come to question the implicit assumptions invoked by the idea that one can listen to the thing-we-call-the-heart *itself* or sense the thing-we-call-the-body *itself*, with or without biosensors. In this thesis I address the value-laden character of the design of any technology, in particular those directed at human bodies, and employ Foucault’s notion of the *medical gaze* as it persists across disciplines. I foreground Barad’s notion of *intra-action* to articulate approaches to design that take as their starting point the multiplicity and relationality of all ‘things’ (human and nonhuman)—things which only become intelligible as one particular thing by way of their entangled-differentiation with other such things. Turning the mirror back on my own collaborative practice-as-research with composer John MacCallum I detail our conception of *critical appropriation*, that is, the intentional de- and re-contextualization of ‘technologies’ (e.g. tools, objects, concepts, methods, metrics) between disciplinary cultures as a means to probe their ethical and aesthetic boundaries. Critical appropriation is a *diffractive* methodology, in that it is a means to shape a context in which insights from diverse

communities spill through and around one another, illuminating the ways in which they include and exclude different knowledges, as well as the effects these differences make over time. Throughout this thesis, I weave disparate knowledges about bodies and movement to cultivate cross-, inter-, and trans-disciplinary discourses that require the effects produced by critical differences in perspectives to thrive. The contribution that this thesis makes is performative: I enact critical appropriation to produce the conditions for diffractive encounters between bodies-of-knowledge in medicine, art, and philosophy over the course of epochs.

Dedication

To John and Laura, *with heart*.

Acknowledgements

Firstly, I would like to express my sincere gratitude to my Director of Studies, Dr. Simon Ellis. One could not ask for a more thoughtful, patient, and committed advisor. In all areas of my practice-as-research, written and chorographic, and as I worked through entangled aesthetic, conceptual, and logistical concerns, Simon's availability, curiosity, and enthusiasm were above and beyond my expectations. Likewise, my Doctoral Advisors Professor Scott deLahunta and Professor Sarah Whatley have been truly exceptional. The depth and rigour of their feedback inspired and challenged me every step of the way. Having Simon, Scott, and Sarah together as a team was a great privilege; their encouraging yet critical voices will resonate long beyond my PhD.

Sincere thanks as well to my Examiners, Dr. Joanne 'Bob' Whalley and Dr. Hetty Blades, for their generous engagement in the examination process. It was an honour to have feedback and dialogue with two such inspiring artists/scholars.

To John—your immense generosity and care throughout my PhD has been overwhelming. The entanglement of our lives, personally and professionally, is implicit in each page of this thesis. Our collaboration over the past six years has transformed my ways of seeing, thinking, moving, and being. Thank you for reading and giving feedback on my thesis many, many, many times over!

My heartfelt thanks extend to Laura Boudou, who has collaborated with John and I as a dancer since the start of my PhD three years ago. Laura has been integral to the ongoing development of performances, as well as to the practice of Relational Listening

discussed in my thesis. Laura's persistent curiosity, dedication, and warmth—and expert massages!—have helped me through some of the tougher moments of my PhD.

Thank you to everyone at the Centre for Dance Research (C-DaRE) at Coventry University for being such a brilliant community of artists and scholars. Special thanks to my fellow PhD candidate Emilie Gallier for our ongoing exploration of the 'confluence' of our practices, and for organizing a practice-as-research group at C-DaRE.

I am sincerely thankful to my family and friends for their support throughout my PhD. To my mother Christine Jackson, my father John Naccarato, and my sisters Alessandra and Gabrielle, thank you for your understanding and care as I tried to balance 'everything' over the past few years. To my life-long friends, Ana, Micha, Summer, and Kaitlin—your presence from afar is always felt. Finally, thank you to Omar Nasar for giving me a home away from home in London, and to my cat Shae for reminding to sleep, eat, and play each and every day.

Statement on authorship

I certify that this thesis is my own work and has not been submitted in any form for award of a higher degree elsewhere. Moreover, it does not contain material previously published or written by another person, except where due reference is made in the text of the thesis. As indicated using footnotes on section headings and subheadings, I draw on material from four of my own publications throughout, three of which are co-authored: Naccarato 2018, Naccarato and MacCallum 2016, 2017, 2019. I confirm that this research has been conducted in adherence to Coventry University's research ethics policy.

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List of Publications

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MacCallum, J. and Naccarato, T.J. (2019) ‘Collaboration as Differentiation : Rethinking Interaction Intra-Actively’. *Performance Philosophy* 4 (2), 410–433

Naccarato, T. J. (2018) ‘Artistic Practice as Research: A Genealogical Account’. in *A World of Muscles, Bone & Organs: Research and Scholarship in Dance* [online] ed. by Ellis, S., Blades, H., and Waelde, C. 435–455. available from <<https://www.coventry.ac.uk/PageFiles/276435/AWofMBandO.pdf>>

Naccarato, T. J. and MacCallum, J. (2017) ‘Critical Appropriations of Biosensors in Artistic Practice’. in *Proceedings of the Conference on Movement and Computing (MOCO)*. held 2017 at London

Naccarato, T. J. and MacCallum, J. (2016) ‘From Representation to Relationality: Bodies, Biosensors and Mediated Environments’. *Journal of Dance & Somatic Practices* 8 (1), 57–72

Chapter 1: Introduction

Openings

I.

My artistic practice-as-research has no point—no primary point, no focal point, and no ultimate point. This lack, this pointlessness, is the opening in which we begin.

II.

In trying to locate the ‘heart’ of my artistic research—its pump, its pulse, its propulsion between stage and page—I find my logic circling, and circulating, unable to perform vivisection without stilling, without killing. When I cut into the live flesh of my practice, when I attempt to transplant its heart into foreign bodies, I make a fundamental shift to its ontology. When I cut into the flesh of my writing-moving-making-thinking, it is the tip of my own scalpel that becomes the point—a point of transgression, a point of contamination, a point of penetration between bodies-of-knowledge.

III.

The body of this text is a matter of bodies folding into bodies, folds upon folds, without compacting, without closing, without finitude. This body (this text) folds to open, moving always (if imperceptibly)—and “movement is the qualitative multiplicity that folds, bends, extends the body-becoming toward a potential future that will always remain not-yet” (Manning 2009: 17). The body of this text, as a body-of-knowledge, is always not-yet. To examine this body-becoming, I must examine its folds, its folding of knowledges, from which and as which knowledges proliferate.

IV.

Encounters between bodies-of-knowledge can be generative, but also violent. A ‘body-of-knowledge’ is a discourse that sustains notions of truth and mastery, of matter and meaning, within and between communities of research. The boundaries of bodies-of-knowledge are enacted continuously through the inclusion and exclusion of different knowledges, and thus, remain vulnerable to destabilization via contact with foreign bodies. Every body-of-knowledge has flesh, animate and inanimate, material and immaterial. Multiple bodies-of-knowledge traverse each and every other body-of-knowledge, emerging as bodies only through their sustained differentiation, yet entanglement.

V.

Acts of appropriation, as well as collaboration—varied in consent and intent—foreground disciplinary boundaries as sites of inter-penetration between bodies-of-knowledge. With the inevitable and ongoing movement of technologies between communities of practice, so too is there a movement of ethical and aesthetic values that may come to inform interpretations and representations of bodies and movements over time.

VI.

To a point: that which constitutes my thesis as a body-of-knowledge is entangled with that which I hope my thesis may do—that is, cultivate cross-disciplinary discourse on the ways in which different knowledges *about*, *in*, and *as* different bodies and movements come to matter differently in the world.

VII.

At the heart of my collaborative practice-as-research is care for the ceaseless circulation and cross-contamination between living, breathing bodies-of-knowledge—without recourse to vivisection.

Thesis Overview

I begin from the premise that it is very common for ‘technologies’ (tools, techniques, theories, taxonomies, texts, traditions, time, truth, etc.) to be used in different ways by different people in different contexts. Any one technology can *be* and *do* many things. This fork in my hand may be for eating, or it may become a weapon. A stethoscope may be used by a doctor to support diagnosis, or it may be the tool of choice for a criminal cracking a safe. This toilet may be for urinating, or it may become art. Words and ideas—as technologies—can be re-appropriated too: the term ‘bitch’ may be intended as an insult, or it may be re-claimed to describe ‘strong’ and ‘assertive’ women. The notion of ‘difference’ can be a means to identify and honour diverse perspectives as they come to matter for particular people in particular ways, but it can also be a means to categorize and essentialize *this* from *that*, *us* from *them*. What I wish to emphasize here is not difference *itself*—different technologies used differently by different people in different contexts—but rather, the *effects that different differences make in the world*.

To say that technologies are used in different ways is not commensurate with a discussion of the effects of the appropriation of technologies, and certainly not with a discussion of the effects of the *critical* appropriation of technologies. In this thesis, I appropriate the notion of ‘appropriation’ to emphasize the power dynamics involved in the transit of technologies between disciplinary cultures. By appropriation I mean *taking*

and making one's own—with or without consent, and with or without acknowledgement of transgressions of cultural and disciplinary traditions. In affixing *critical* to appropriation, I offer the provocation that the intentional de- and re-contextualization of technologies can be a catalyst to examine differences that come to matter between communities of practice over time. As a theoretical framing, critical appropriation is related to the re-claiming and re-appropriation of ‘technologies’ (metaphors, symbols, methods, metrics) without assuming said technologies have an originary or singular source. Critical appropriation is a sustained process of taking and making—not the taking of pre-constituted things—but *taking as making* through the ongoing differentiation between *this* and *that*, for *me* and *you*.

The goal of critical appropriation is *diffraction*, a notion that I will elaborate on in Chapter 2 with reference to the work of Haraway (1992, 1997) and Barad (2003, 2007, 2010, 2012, 2014). As a metaphor in research practices diffraction suggests the continual spilling of voices through and around one another, illuminating the ways in which articulations of knowledge resonate differently in differentiated contexts. In diffractive approaches, one cannot assume *a priori* difference between disciplinary bodies-of-knowledge; rather, diffractive methodologies are a means to probe the entangled-differentiation between bodies-of-knowledge as the basis for their intelligibility. For example, I understand *this* discipline as distinct from *that* discipline or any *other* discipline because they each count as *one* discipline among disciplines in the context of academia. *This* discipline can matter differently than *that* discipline only given its sustained relation of difference to each and every other thing-we-call-a-discipline. Relations of difference between disciplines are never stable, and critical

appropriation is a means to interrogate and intervene in the ongoing re/configuration of disciplinary boundaries.

In practices involving critical appropriation, care for the perceived transgression of disciplinary boundaries requires attention to the ways in which these boundaries are sustained via the inclusion and exclusion of different people, practices, and knowledges. The critical appropriation of technologies is a means to examine how these boundaries are *haunted* by different conceptions of what the technology being appropriated *is* and *does*—that is, of how and why it matters *here* and *now*.

Critical appropriation may be described as *destabilizing*; by this I do not mean the destabilization of stable things themselves, but rather, an ongoing innovation of the ways in which the boundaries between differentiated things make a difference. The traversal of disciplinary boundaries can be valuable because, as Barad argues: “If we follow disciplinary habits of tracing disciplinary-defined causes through to the corresponding disciplinary-defined effects, we will miss all the crucial intra-actions among these forces that fly in the face of any specific set of disciplinary concerns” (2003: 810). Critical appropriation is inherently cross-disciplinary—without assuming disentangled disciplines that act on one another from without.

The ongoing discussion of critical appropriation and diffraction throughout this thesis is not offered as an indiscriminate celebration of cross-, inter-, or trans-disciplinary research; I proceed with care, from the premise that the transit of ‘technologies’ (ideas, images, idioms, sounds, scores) between disciplinary cultures may reveal aspects of their implicit value systems—that is, the constitutive exclusions that have become critical to their seeming stability as distinct bodies-of-knowledge. This revealing of

value systems, which is necessarily a matter of interpretation and representation, also invites interrogation of the power dynamics through which particular conceptions of things like knowledge and research are maintained—at the expense of others.

With the appropriation of technologies from one discipline to another it is crucial to examine the ongoing collision of implicit value systems—collisions which, if left unexamined, may lead to the subordination of the values of one discipline in favour of another. In the case of the appropriation of biosensor technologies from medicine into art, these values concern the ontological status of the thing-we-call-the-body, as well as its parts, physiology, and movements. These ontological concerns cannot be disentangled from epistemological, ethical, and aesthetic tactics employed in representations of bodily things, and likewise in the design of interaction between such things. As artists de- and re-contextualize biosensors as well as biosensing techniques such as sonification, biofeedback, and biocontrol, they, or rather ‘we’, have an opportunity to interrogate entangled value systems—from phenomenology to structuralism, materialism to constructivism, and poststructuralism to new materialism—that not only enable but constrain the intelligibility of different things within our frames of reference.

Given the sustained appropriation of sensing technologies in my collaborative practice-as-research, I find myself implicated in discourse about the human body, as well as bodily processes and movement, in medicine, computer science, human-computer interaction, science and technology studies, and feminist and process philosophies. As I thread disparate knowledges throughout these pages, I make no attempt to reconcile differences in conceptions and representations of bodies; on the contrary, I seek to

foreground the destabilizing yet generative potential of continual processes of differentiation between bodies-of-knowledge—which remain always-already entangled with other bodies-of-knowledge.

The contribution that this thesis makes is not only explicative, but performative. As author I have shaped this thesis as a context in which diffractive encounters may (or may not) emerge between diverse knowledges. The convergence and divergence of bodies-of-knowledge throughout this document is an invitation for encounters in which insights—artistic, scientific, and philosophical—spill through and around one another, creating interference and entanglement. Through diffraction between bodies-of-knowledge, the constitutive exclusions that sustain bodily boundaries may themselves become apparent, or even troubled—re/configuring relations of intelligibility within and between cultures of research, and inspiring cross-disciplinary innovation and collaboration.

In the remainder of this introduction, I position my long-standing collaboration with composer John MacCallum as the basis for my doctoral practice-as-research. Further, I provide an overview of key questions in each chapter, tracing the stakes of diffractive encounters between bodies-of-knowledge over the course of centuries, and over the course of this thesis.

Background of my practice-as-research

My background is as a choreographer and contemporary dancer, and I have long worked with sensing technologies in performance. I have been collaborating with John MacCallum, who is a composer and computer scientist, over the past six years to

develop a body of work that we call *III*. We share our practice-as-research in *III* through workshops, performances, installations, videos, publications, and in more hybrid forms. John and I have also been collaborating with dancer Laura Boudou since the start of my PhD three years ago in the context of research and creation residencies and events. My collaborative practice-as-research in *III* is the basis for my doctoral practice-as-research. As such, I will narrate some key concerns that emerged for me, and for us, in the early stages of integrating biosensors in our collaboration.

I first began working with heart rate sensors in 2013 to develop what I imagined was a single production with John. In this evening-length event, we envisioned twelve dancers wearing ECGs, executing choreography designed to modulate their heart rate according to prescribed temporal arcs in a musical score. The real-time ECG signal from each dancer would in turn be used to produce a click-track for twelve corresponding musicians, driving their progression through a given part in the polytemporal musical score—hence providing a form of biofeedback for the dancers. In a series of initial performance studies we tested aspects of our plan, for example having dancers wear ECGs and either improvise or perform set material intended to modulate their heart rate according to a prescribed score while receiving biofeedback—and indeed, the dancers (myself included) succeeded in reproducing similar arcs in heart rate time and again.

This seeming success, however, was tempered by the realization that in order to reproduce and represent the physiological behaviour of the heart of each dancer according to our aesthetic vision as choreographer-composer, we had to gloss over integral aspects of the heart's behaviour—that is, its variation and unpredictability from beat-to-beat, in relation to entangled physiological, behavioural, and environmental

processes. This may seem insignificant—who cares if we smooth out variability in a heart rate signal in a dance and music performance? The thing is, heart rate variability is what points to the world beyond the heart—to its material-discursive entanglement with all that is other-than-heart within and beyond the boundaries of the thing-we-call-the-body. In erasing heart rate variability from a sonified ECG signal, we effectively erase all reference to the context in which the heart performs—including the rest of the body and its movements in a particular time and place—as the basis from which the heart may be represented as a self-contained thing. Our concern as choreographer-composer was not that we might produce inaccurate or incomplete representations of the behaviour of the heart—we most certainly will, given our training in music and dance as opposed to cardiology. Rather, we began to suspect that perhaps the dynamic and unpredictable behaviour of the human heart, or at least, interpretations of its biosignals, was an opportunity to inspire unfamiliar bodily, technological, and temporal entanglements in performance—re/configuring our sense of the boundaries of our own aesthetic values and authority as choreographer-composer.

Some six years later, in the body of work we now call *III*, John and I explore visual, sonic and haptic representations of biodata as a means to intervene in notions of direct or un-mediated access to the thing-we-call-the-body and its various parts and processes—because we do not believe bodily things exist in and of themselves. The intervention of biosensors in our choreographic-compositional authority is destabilizing-yet-generative, in terms of illuminating the boundaries of our own aesthetic frames of reference—and the ethical implications of the constitutive exclusions that bound these frames. The persistence of our collaboration, well beyond our initial plan for a single performance, is inspired in part by our mutual appreciation

of the ongoing processes of differentiation-yet-entanglement between our respective notions of things like the body, the heart, biology, movement, time, space, and even choreography and composition themselves. Through the critical appropriation of technologies into our collaborative practice-as-research we examine aesthetic, ethical, technical, and conceptual concerns related to control, representation, and interaction between bodies and technology—with care for differences that come to matter between us, and within the communities in which we engage.

Thesis outline and guiding questions

Throughout the pages of this thesis my logic circles and circulates, encountering frequent interruptions and redirects which are themselves integral to the point. While each chapter builds upon the next, the continual opening and re-opening of ideas invites transversal reading to connect ‘points’ within and beyond the body of the text.

In the coming chapter I discuss my collaborative work in *III* further, and address the entanglement of this thesis with other iterations of my practice-as-research. The next chapter is, in a sense, a continuation of the introduction in that it provides additional framing for my work, and foregrounds the diffractive and performative potential of this thesis. In chapters 3 through 7 the thematic scope of my thesis broadens exponentially, traversing bodies-of-knowledge in medicine, art, and philosophy over the course of centuries as an invitation for diffractive readings. As a guide through chapters 3 to 7, I have identified key questions—questions which invariably open to other questions, which in turn open to other questions, and so on and so forth—without closure or resolution. The ongoing entanglement of questions within and between chapters means that their boundaries are sites of continual cross-contamination and inter-penetration

between bodies-of-knowledge. Although ‘points’ may become intelligible within the body of each chapter, diffractive encounters with other bodies may illuminate why and how these points matter differently for different people in different contexts. From Chapter 3 through 7, the key questions are as follows:

Chapter 3: What is this thing-we-call-the-body? Is the human body a thing like other things? Is the dancing body a thing in-itself? In movements such as Cartesianism, phenomenology, structuralism, materialism, constructivism, feminism, and new materialism, how do bodies and other-than-bodies become differentiated, yet remained entangled, within and between disciplinary bodies-of-knowledge?

Chapter 4: What is this thing-we-call-the-heart? From antiquity to present day, how has human anatomical dissection and transplantation contributed to understandings of the human heart in relation to the human body, brain, and soul—in life and death? How can an examination of the ontological multiplicity of the heart point to entangled ethical and aesthetic concerns in medical and artistic research alike?

Chapter 5: Since the early-mid 19th century, how has the development of biomedical sensors shifted the boundaries of intelligibility of the human body, without recourse to cutting? With the appropriation of biosensors from medicine into the arts, for example in music composition, how can the motives, methods, and modes of articulation of researchers be differentiated, and therefore made intelligible, within and between bodies-of-knowledge?

Chapter 6: How can the transit of technologies between disciplinary cultures illuminate the ways in which boundaries are continually enacted through the inclusion and exclusion of different people, practices, and knowledges? As choreographer-composer,

how do we appropriate critically, interrogating the material-discursive practices that differentiate our knowledges from other knowledges, and our research from other research?

Chapter 7: How can we rethink interaction *intra-actively*, that is, without assuming pre-constituted ‘things that interact’? Likewise, how can we approach collaboration *diffractively*, that is, with care for differences as they become critical?

The above questions are reiterated at the opening of each chapter as a guide. But before we dive into the tumults of the text, I will provide additional framing with regard to key themes and methods employed throughout my thesis, and in my practice-as-research more broadly.

Chapter 2: Diffractive methodologies in (my) practice-as-research

Introduction

So location is about vulnerability; location resists the politics of closure, finality, or to borrow from Althusser, feminist objectivity resists “simplification in the last instance.” That is because feminist embodiment resists fixation and is insatiably curious about the webs of differential positioning. There is no single feminist standpoint because our maps require too many dimensions for that metaphor to ground our visions. (Haraway 1991: 590)

In this chapter I provide multiple, mutable framings of my thesis in relation to—and as part of—my ongoing, collaborative practice-as-research with composer John MacCallum. I detail significant themes in our work such as *differentiation*, *entanglement*, and *critical difference*, and emphasize the inherent plurality of any act of authorship. Turning to the entanglement of the thing-we-call-practice and the thing-we-call-theory within the thing-we-call-research, I raise challenges concerning reflexivity, and admit failure with regard to pinpointing my ‘self’ myself in my practice-as-research. Drawing on Haraway and Barad, I foreground diffractive methodologies as integral to interrogating the boundaries of intelligibility of bodies-of-knowledge within and between disciplinary cultures—spilling insights through and around one another—without stilling processes of entangled-differentiation between self/other, body/world, and matter/meaning. Finally, I speak to the sharing of my practice-as-research in the context of my PhD, not only in this thesis, but through a workshop-performance event. In this event, as in my thesis, I shaped a context aimed at facilitating diffractive encounters between participants—human and nonhuman, material and discursive,

immediate and mediated—as the basis for vulnerable-yet-generative destabilization and innovation within and between disciplinary domains.

Framings of my practice-as-research

On differentiation: Three (III), not two (II)

John and I call our ongoing collaboration, and the body of work we have developed for page, stage, and installation *III*. *III* may be interpreted to be about many things: most urgently, perhaps, *III* is an investigation of the multiplicity and relationality of all ‘things’ as entanglements. These “entanglements are not intertwinings of separate entities, but rather irreducible relations of responsibility” (Barad 2010: 265). For us, *III* points to proliferation.

But why *III*, and not *II*?

We are suspicious of *II*. *II* has done too much damage in the world, splitting people and things into objects of binary thought: body/mind, subject/object, cause/effect, us/them, self/other. In the movement from *II* to *III*, there is a multiplication of relationships: no longer are *A+B* left to duel alone, for *III* requires negotiation between *A+B*, *B+C*, and *C+A*, as well as *AB* in relation to *AC*, and *AC* in relation to *BC*. In the deconstruction of *III*, we inevitably encounter many *IIs*, and *Is* as well, but of import is that as part of *III*, these *Is* and *IIs* are always-already in relation to other *Is* and *IIs*, and these relations multiply rather than reduce difference. They multiply, because in order for *I* to become conceivable as a thing other than all other *Is* (and then, to interact with other *Is*), this *I* must become differentiated from all other *Is*. This differentiation is a matter of punctuation rather than termination of the entanglements between multiple *Is*. In the

continual processes of differentiation for each I within III differences accumulate, and these differences demand differentiation from other differences in order for their effects to make a difference in the world.

But do all differences matter? How do different differences come to matter for different people, in different contexts? In *III* we do not seek difference for difference's sake, nor difference in relation to originary sameness. In *III* we seek "...a theory of 'difference' whose geometrics, paradigms, and logics break out of binaries, dialectics, and nature/culture models of any kind" in favour of "irreducible difference and radical multiplicity of local knowledges" (Haraway 1991: 129, 187). In *III* we seek 'critical' difference, that is "difference that has crossed an inflection point, difference that has been brought to a point of critical mass, difference that is essential to a context and that must be cared for in order to prevent it from becoming flattened" (MacCallum and Naccarato 2019: 424).

In the performances and installations that we develop as part of our practice-as-research in *III*, we approach questions of difference by devising scenarios in which we selectively constrain access to the event for different people in different ways. We do this by experimenting with the configuration of the audience in space, and with the use of technologies like individual monitors, mirrors, headphones, and transducers, in order to foreground the unique frame of reference of each audience member as creative and constitutive of the 'choreography' and 'composition' itself.

An underlying assumption in our approach to designing events in *III* is that in the course of any encounter, 'we' (performers and public alike), each become aware of and care about different details, to the exclusion of others. The boundary between that which we

notice and do not notice, hints at what matters to us and for us, in this situation. As we become implicated as participants in a given context, the perceptibility of different ‘things’ in this context (e.g. bodies, or bodily processes and movements), is not an attribute of these things themselves. Rather, the visibility, audibility, or even conceivability of these things as things emerges in relation to our individual frame of reference.

The use of sensing technologies in *III*, from mirrors to video cameras to biosensors, is not, for us, a means to extend access to or produce representations of bodies and movements. Rather, we use sensing technologies to encourage sensing of the boundaries of one’s own frame of reference—and the sensing of this sensing as well—as a transient site of continual differentiation between the perceptible and imperceptible, the significant and insignificant.

Our interest in *III* is not so much in *why* we each perceive differently; rather, we are interested in the effects these differences make in our relationships, and in our ways of relating—personally, professionally, socially, politically, and playfully. These relationships and ways of relating may emerge both within and between disciplinary cultures, from the arts to humanities to sciences. The question for us in *III* is this: when ‘we’ (any we) cannot perceive or experience events in the same way (and I would argue that this is always the case), how do we continue to ‘engage’—to collaborate, to cooperate, to communicate—without collapsing the differences that make our relationships meaningful to us and for us? Further, how do these ways of relating become integral to the thing-we-call-our-work *itself*?

On authorship: The ethics of ‘we’

This thesis is part of my ongoing collaboration with composer John MacCallum in *III*.

And yet, this thesis is authored by ‘me’, not ‘us’—‘I’, not ‘we’.

‘We’ is an indication and provocation of many things in this thesis. ‘We’ is not a combination of Is, such that I can later be subtracted from ‘us’, re/claiming my singularity (as if I were not always-already multiple). ‘We’ is an irreversible operation. ‘We’ is an entangled-differentiation. And yet ‘we’ are not one, or even only two.

‘We’, John and I, identify as a composer and choreographer respectively. We have been collaborating for six years now. We do not wish to speak for each other, but we also cannot speak without each other—and without other others—in the sense that we have become implicated in each other’s bodies-of-knowledge. My voice, my perspective in our collaboration, becomes identifiable to me as mine through its differentiation from John’s, and from all of its other implicit ‘others’—others such as other collaborators, mentors, friends, authors and artists—whilst remaining entangled with these others.

This differentiation is not a matter of dividing one body-of-knowledge into two, nor of adding two bodies together, or not even of multiplication between my body and another.

‘We’ remain entangled because the differentiation of our bodies-of-knowledge involves the multiplication of the multiple (indeterminate) effects of the differences that come to matter between our bodies-of-knowledge.

Philosophers Gilles Deleuze and Félix Guattari—who I draw on here not only for their ideas, but for their history as collaborators¹—comment on the plurality of any act of authorship:

The two of us wrote *Anti-Oedipus* together. Since each of us was several, there was already quite a crowd. Here we have made use of everything that came within range, what was closest as well as farthest away. We have assigned clever pseudonyms to prevent recognition. Why have we kept our own names? Out of habit, purely out of habit. To make ourselves unrecognizable in turn. To render imperceptible, not ourselves, but what makes us act, feel, and think. Also because it's nice to talk like everybody else, to say the sun rises, when everybody knows it's only a manner of speaking. To reach, not the point where one no longer says I, but the point where it is no longer of any importance whether one says I. We are no longer ourselves. [...] We have been aided, inspired, multiplied. (Deleuze and Guattari 1980: 3)

Since the onset of their collaboration, to speak of the work of Deleuze is to speak of the work of Guattari, and vice versa. Although Deleuze and Guattari have each published individually, and in fact have different disciplinary backgrounds (as a philosopher and psychoanalyst respectively), it would be difficult, and perhaps unethical, to deny their implicit presence in one another's work. The point here is not to collapse Deleuze and Guattari into a single author ('Deluattari, or 'Gualeuze'?), but rather, to acknowledge that through their collaboration they have each "been aided, inspired, multiplied", and in this multiplication, they can no longer be identified as only one, or even as only two.

Through collaboration, John and I interrogate our relationship as a site of irreducible and irreconcilable difference—difference as in "differencing: differences-in-the-

¹ For further discussion of Deleuze and Guattari's sustained collaboration and understanding of co-authorship see *The Anti-Oedipus Papers*, a collection of journal entries addressed by Guattari to Deleuze between 1969-1972 (cited as Guattari 2006). The "Introduction" by the editor Stéphane Nadaud provides valuable context for the *Papers*, including quotes from Deleuze's perspective.

(re)making” (Barad 2014: 175). We understand the entanglements *of, in, and as* our bodies-of-knowledge to be at once generative and destabilizing to our personal and professional identities. From early in our collaboration, we realized that our conceptions of ‘things’ as fundamental to our disciplines as bodies, movement, time, space, and even the practices of choreography and composition themselves, are not the same. While digging into the differences in our knowledges can make co-authorship tense—tense in the sense of mutual resistance to collapsing the spaces between us—we seek to rest in that tension. We do not wish to collapse our differences because it is our stubborn care for these differences in their fine details which sustains our need for one another as partners and collaborators. These differences constitute our entanglement.

For us, *III* is not only a project *about* difference and multiplicity. Rather, *III* is a project through which we cultivate and care for differences as they come to matter in the relationships between people, ideas, movements, methods, and materials integral to our creative process—personally and professionally. We aim to design spaces for cross-, inter-, and trans-disciplinary collaboration that not only accommodate difference, but which require the effects produced by critical difference to thrive. In this thesis, as in other aspects of *III*, I gather disparate perspectives—from choreography, dance, medicine, interaction design, and philosophy—and craft conditions in which differentiated knowledges may spill through and around one another.

On entangled knowledges

What I offer you here are entangled threads from the many ‘practices’ (writing, moving, reading, thinking, listening, touching, fucking, etc.) through which I make sense *in and of* the world. You, the reader, may or may not have participated in other aspects of my

collaborative practice-as-research in *III* (e.g. performances, installations, workshops).

No matter: this text stands alone, just as other iterations of *III* stand alone.

To stand alone, however, is not to lack relation. On the contrary, the different things that I create—and the knowledges and know-how that circulate *in*, *as*, and *about* them—cannot but be in relation. This is not because they share an original seed—me—from which one may trace their lineage. As author, I am multiple and multiplied with ‘others’ *in* and *as* the knowledges I produce, even as these knowledges produce iterations of ‘me’ and ‘mine’. These knowledges are also not rooted in one another, nor in any other ‘one’ from which they grow. Knowledges (in ‘practice’, in ‘theory’) are always-already entangled, and moving transversally “between things”:

Between things does not designate a localizable relation going from one thing to the other and back again, but a perpendicular direction, a transversal movement that sweeps one and the other away, a stream without beginning or end that undermines its banks and picks up speed in the middle. (Deleuze and Guattari 1980: 25)

In the speed of the middle—multiple middles—differentiated articulations of practices and theories remain unrooted, without identifiable points of initiation, intersection, or impact. They lack foundation. They lack coordination. They are pointless. But in their pointlessness, they remain fertile: they produce not by acting upon one another, but rather, by multiplying the effects generated in the course of their continual differentiation. In this multiplication of effects, the differences that the things-we-call-practices and the things-we-call-theories come to make in the world become indivisible, entangled.

The effects of differentiating between ‘practice’ and ‘theory’ in the thing-we-call-research—in the sciences, humanities, and arts alike—cannot be disentangled from the

effects produced by the boundary between ‘research’ and ‘not-research’. The concept of practice-as-research, and its relatives practice-based, practice-led, or simply practice research, can be understood as attempts to foreground the value of disciplinary approaches (for example in art) which may be unintelligible as Research within post-Enlightenment framings of scientific knowledge in academia. The differentiation between artistic practice-as-research on the one hand, and artistic practice that is something *other* than research (art?) on the other, requires the maintenance of a boundary between the two (i.e. research and art); this boundary is sustained through the continual exclusion of knowledges that are unintelligible as research within this frame. In bringing awareness to the ethical weight of exclusion by which the boundaries of knowledge in a given practice of research—including practice-as-research—are continually enacted, the operation of the implicit value systems that police its borders, and border crossings (from ‘practice’ to ‘theory’, from ‘art’ to ‘research’), may themselves be interrogated from within and as part of this research practice itself.²

In this thesis, I use the concept of practice-as-research to refer to every-thing I do—practically and theoretically, materially and discursively, personally and professionally—which is to say, I do not consider my practice-as-research to be about any-one-thing—practical or theoretical, material or discursive, personal or professional. This is not to say that my research has no bounds, or that I have no frame of reference—*it does, I do!* The continual enactment of the boundaries of a body-of-knowledge *in* and *as* my doctoral research involves the differentiation between those ‘things’ (e.g. ideas,

² I address themes from throughout this paragraph in my publication: “Practice-as-Research: A Genealogical Account” (Naccarato 2018). See Appendix C for the full article.

practices, people, theories, methods) which become intelligible to me as things that matter most—as matters of critical difference in a discourse about critical difference. This coming to matter involves an entanglement of what I think these things may be (ontology), with how I come to know these things (epistemology), and finally, with how and why I think these things make a difference (ethics). Barad refers to this entanglement of ethics with knowing and being as “ethico-onto-epistemology”, and emphasizes that:

We don’t obtain knowledge by standing outside the world; we know because we are *of* the world. We are part of the world in its differential becoming. [...] the possibilities for what the world may become call out in the pause that precedes each breath before a moment comes into being and the world is remade again, because the becoming of the world is a deeply ethical matter. (Barad 2007: 186, orig. italics).

Between practice and theory, between art and research, between my personal and professional life—somewhere in these un-localizable middles—is where the differences that matter to me multiply.

But how now, do I point at these ‘things’ that come to matter to me in the world (my world)? How now, do I point back at myself-becoming, locate my ‘self’ pointing to possible ‘others’ within and between bodies-of-knowledge? *Where is my body?*

On reflexivity: The ‘one’ in the mirror

In search of my own body (of knowledge)—its heart, and its constitutive exclusions—I look at myself in the mirror. When I look in the mirror, the ‘one’ staring back at me cannot account for that which I do not see—for that which is beyond its frame—I mean ‘my’ frame of reference. As a choreographer, I engage in reflexive practices such as journaling and reviewing video documentation in order to critically reflect on and situate my work in relation to other work—and then, I reflect on my practice of

reflecting on my work, and on my practice of reflecting on my practice of reflecting on my work. Mirrors upon mirrors upon mirrors—to infinity. And yet, that ‘one’ still stands staring back at me through my own stubborn eyes. That ‘one’ cannot tell you where my body is—nor where my body is not.

Of one thing I am certain: I do not possess the universal vision required to situate my knowledge in relation to all other knowledges. I cannot point to myself as subject, objectively, from without—even from a marginal position.³ I cannot adequately contextualize myself, as if, until this moment in the text, I was without context. I am standing here and now, and now, here—but to tell you my ‘absolute coordinates’ in a Cartesian sense, we would have to agree on a common origin from which I diverged.⁴ What if ‘we’ do not have a common origin?

Never mind, I will draw you a map of my body (of knowledge) relative to other bodies (of knowledge): my body is situated somewhere inside the bellies of dance and somatic practices, choreography and composition, interaction design, and feminist and process philosophies. I will trace more precisely page after page, but despite my precision, the boundaries of my map will remain within the boundaries of my body-of-knowledge; my map can only illustrate that which I am presently aware of and conceive of as relevant,

³ In “Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective”, Haraway discusses the value yet limitations of ‘standpoint feminism’, arguing that: “The standpoints of the subjugated are not ‘innocent’ positions. On the contrary, they are preferred because in principle they are least likely to allow denial of the critical and interpretive core of all knowledge. They are knowledgeable of modes of denial through repression, forgetting, and disappearing acts – ways of being nowhere while claiming to see comprehensively” (1988: 584).

⁴ For an explanation of Cartesian coordinates, see Kent and Vujakovic 2017: 190. For further discussion of Cartesian coordinate systems in relation to notion of ‘objectivity’ in theatrical performance, see Gobert 2013: 39.

to the exclusion of all else, all others. I am responsible for these exclusions, even if they are invisible to me.

Feminist theorists working in science and technology studies (STS) in the late 1980s onwards brought awareness not only to the subjectivity of individual researchers, but also to the power relations involved in the production of scientific knowledge. Rejecting traditional notions of objectivism and relativism, proposals associated with standpoint feminism such as Sandra Harding's "strong objectivity" (1992), and Donna Haraway's "situated knowledges" (1988, 1992, 1997), insist on locating the researcher in the research process, and the research process in a broader social and cultural matrix of power relations. Building on Harding's work, Haraway explains that:

Strong objectivity insists that both the objects and the subjects of knowledge-making practices must be located. Location is not a listing of adjectives or assigning of labels such as race, sex, and class. Location is not the concrete to the abstract of decontextualization. Location is the always partial, always finite, always fraught play of foreground and background, text and context, that constitutes critical inquiry. Above all, location is not self-evident or transparent. (Haraway 1997: 37)

While acknowledging the valuable contribution of reflexive methodologies in feminist approaches to research, Haraway expresses suspicion regarding their potential to pinpoint a subject (self) in relation objects of interest (others), and therefore to locate points of critical difference as they come to matter (1997: 16). In Haraway's own words: "my suspicion is that reflexivity, like reflection, only displaces the same elsewhere, setting up the worries about copy and original and the search for the authentic and really real" (1997: 16). Reinforcing this sentiment, Barad argues that:

[R]eflexivity is nothing more than iterative mimesis: even in its attempts to put the investigative subject back into the picture, reflexivity does nothing more than mirror mirroring. Representation raised to the nth power does not disrupt the geometry that holds object and subject at a distance as the very condition for

knowledge's possibility. Mirrors upon mirrors, reflexivity entails the same old geometrical optics of reflections. (Barad 2007: 87)

From maps to mirrors, reflexive tactics alone are insufficient to account for the constitutive exclusions through which researchers and research practices become situated. As researchers, we are part of research cultures in their differential becoming, and as such, cannot identify their boundaries, or rather, *our* boundaries, from without. At stake here is the illusion of increased transparency and accountability for the effects of one's research, whilst maintaining the boundaries beyond which other(ed) knowledges remain unintelligible.

On diffractive methodologies in practice-as-research

The metaphor of 'diffraction' was adopted by Haraway from quantum physics into STS as an alternative to reflective and reflexive approaches (1992, 1997). Haraway describes diffractive approaches in qualitative research as a means to map not only the points "where differences appear, but rather [...] where the *effects* of difference appear" (1997: 300, orig. italics). The metaphor of diffraction and its value as a research methodology has been further elaborated by, and is widely attributed to Barad (2003, 2007, 2010, 2012, 2014)—even as Barad acknowledges the genealogical roots of diffractive methodologies in contemporary feminist discourse (2014). In addition to acknowledging Haraway, Barad points to the work of Trinh Minh-ha (1988) and Gloria Anzaldúa (1987) as integral to her articulation of diffraction in feminist practices of research (2014). The desire for diffractive methodologies is increasingly evident in publications about cross-disciplinary research in arts and education alike; see for example: van der Tuin (2014), Thiele (2014), Taylor (2016), Myers et al. (2017), Lanas

et al. (2017), Bozalek and Zembylas (2017), Moxnes and Osgood (2018), and Murriss and Bozalek (2019).

The metaphor of diffraction can be understood through its differentiation-yet-entanglement with the metaphor of reflection. Whereas reflection refers to the bouncing back of waves from a barrier (e.g. a wall), diffraction refers to interference in the trajectory of waves as they pass through or around obstacles (e.g. waves in the ocean crashing through and around jagged rock formations). In their actualization as metaphors in research methodologies, reflection and reflexivity suggest the bouncing of ideas or perspectives off one another, such that they become displaced elsewhere, and may then shine light back on themselves, or on other people and things from without.

Diffraction, on the other hand:

does not fix what is the object and what is the subject in advance, and so, unlike methods of reading one text or set of ideas against another where one set serves as a fixed frame of reference, diffraction involves reading insights through one another in ways that help illuminate differences as they emerge: how different differences get made, what gets excluded, and how those exclusions matter. (Barad 2007: 30)

Diffraction is not a tool by which an individual subject may locate an ‘object of interest’ (including one’s self, one’s body, or one’s body-of-knowledge); rather, diffraction is a means to probe the production of boundaries—between self and other, between practice and theory, between art and science—as a process integral to the research methodology itself (Bozalek and Zembylas 2017). Barad elaborates that:

[diffraction] is not just a matter of interference, but of entanglement, an ethico-onto-epistemological matter. This difference is very important. It underlines the fact that knowing is a direct material engagement, a cutting together-apart, where cuts do violence but also open up and rework the agential conditions of possibility. There is not this knowing from a distance. [...] Objectivity, instead of being about offering an undistorted mirror image of the world, is about

accountability to marks on bodies, and responsibility to the entanglements of which we are a part. (Barad 2012: web)

When I look at myself in the mirror, the marks on my body, its scars, cannot be accounted for by reflecting on past events. Re/telling stories of how I was cut, in the glory and gore of detail, will never amount to an undistorted representation of these scars as points of transgression, contamination, penetration. These points are not the point, in themselves. These points can only come into account as sites of entangled relation, always-already materializations of internal and external, natural and artificial, self and other.

The self in positioning itself against the other, constituting the other as negativity, lack, foreignness, sets up an impenetrable barrier between self and other in an attempt to establish and maintain its hegemony. The self ('I') only ever sees itself, and not the other. The other, the 'non-I', is consigned to the shadow region, the space behind the mirror. (Barad 2014: 170)

From behind the mirror, the 'other', the 'non-I' cannot see you, and cannot interact with you—and yet, as your other this non-I remains indivisible from you, entangled with you—and, to repeat from earlier: “entanglements are not intertwinings of separate entities, but rather irreducible relations of responsibility” (Barad 2010: 265). Positioning oneself as separate from another involves a contingent and continual process of entangled-differentiation in which self and other become animated as exteriorities-within.

Diffraction is not a matter of interaction between pre-constituted things (self and other, human or nonhuman, material and discursive), in which one thing can be held to account for its effect on the other; rather, diffraction is a matter of what Barad terms *intra-action*, that is: “the mutual constitution of entangled agencies”—agencies which “are only distinct in a relational, not an absolute, sense” (2007: 33). In the intra-activity

of relational agencies, no ‘one’ alone can be held responsible for a boundary, for a scar, for the point at which a cut operates. “Responsibility is not a calculation to be performed. It is a relation always-already integral to the world’s ongoing intra-active becoming and not-becoming. It is an iterative (re)opening up to, an enabling of responsiveness” (Barad 2010: 265). We cannot be solely responsible, but we cannot but be responsible.

To get to ‘the point’, we must examine the point as a site of “cutting together-apart”—a cut of agential separability in which differentiated ‘things’ remain always-already bound, entangled (Barad 2012: web).

On the boundaries of intelligibility

In traditional humanist accounts, intelligibility requires an intellectual agent (that to which something is intelligible), and intellection is framed as a specifically human capacity. But in my agential realist account, intelligibility is an ontological performance of the world in its ongoing articulation. It is not a human-dependent characteristic but a feature of the world in its differential becoming. The world articulates itself differently. (Barad 2007: 149)

In practices of research, diffractive methodologies entail care for differences in their differential articulation. While reflexivity remains integral to self-knowledge, it is insufficient to account for the material-discursive production of the self (of me, of I), in relation to all others. Diffraction is not a replacement for reflection; rather, the effects of different performances of diffraction and reflection in research practices only come to matter *intra-actively*—as they make and break (through) each other. Of importance in diffractive approaches within and between research cultures is an understanding that “[k]nowing entails differential responsiveness and accountability as part of a network of performances. Knowing is not a bounded or closed practice but an ongoing performance of the world” (Barad 2007: 149). As an “ongoing performance of the world”, diffraction

involves ceaseless circulation and cross-contamination between living, breathing bodies-of-knowledge—in and as the indeterminate effects of disciplinary power (Barad 2007: 149).

Probing the boundaries of intelligibility within and which comprise bodies-of-knowledge requires an examination of the effects of disciplinary power as intra-active and diffractive. Foucault argues that:

In itself the exercise of power is not violence; nor is it consent which, implicitly, is renewable. It is a total structure of actions brought to bear upon possible actions; it incites, it induces, it seduces, it makes easier or more difficult; in the extreme, it constrains or forbids absolutely; it is nevertheless always a way of acting upon an acting subject or acting subjects by virtue of their acting or being capable of action. A set of actions upon other actions. (Foucault 1982b: 789)

Disciplinary boundaries, as sites of inter-penetration between bodies-of-knowledge, are enacted iteratively and relationally; the distributed effects of power produce intelligibility, even as intelligibility distributes power asymmetrically across boundaries. The intelligibility of articulations of knowledge as Knowledge, and research as Research, within and between disciplinary cultures, is not an attribute of these articulations in themselves; rather, intelligibility is a relational process of differentiation—always-already, yet not-yet manifest—and never attributable to a singular subject.

In deconstructing the operation of disciplinary power throughout the history of medical, psychiatric, penal, and religious discourse, Foucault argues that constitutions of knowledge cannot be accounted for solely “by historicising the subject”, that is, by positioning the researcher as the producer and transmitter of situated knowledge. Rather, the deconstruction of disciplinary power requires a process of:

[...] genealogy, that is, a form of history which can account for the constitution of knowledges, discourses, domains of objects, etc., without having to make reference to a subject which is either transcendental in relation to the field of events or runs in its empty sameness throughout the course of history. (Foucault 1982a: 117)

For example, in Foucault's genealogy of medical discourse he notes a transformation starting at the end of the eighteenth century and spanning twenty-five to fifty years, during which the medical field:

[...] broke not only with the 'true' propositions which it had hitherto been possible to formulate but also, more profoundly, with the ways of speaking and seeing, the whole ensemble of practices which served as supports for medical knowledge. These are not simply new discoveries, there is a whole new regime in discourse and forms of knowledge. (Foucault 1982a: 112)

In Foucault's account of knowledge, practices and theories are inextricably entangled through the disciplinary effects of power that regulate the boundaries of disciplinary discourse from within. The disciplining of "ways of speaking and seeing" is not a matter of determinism and prohibition, but rather involves continual processes of discursive constraint, through which particular practices contribute to the salient knowledge of a discipline—thus gaining the status of being a practice, or even, a practice that is research.

Diffraction methodologies—such as critical appropriation—are, in a sense, genealogical, in that they attend to the disciplinary operations of power through which and as which bodies-of-knowledge become intelligible. Diffraction methodologies are at once generative and deconstructive: generative via the multiplication of the effects that different differences make in the world, and deconstructive through the entangled-differentiation of the effects of disciplinary power—as impetus for further multiplication. An ethics of persistent care in diffraction readings between texts and

contexts means that ‘we’ are always-already implicated in the production of intelligibility. We cannot perform care solely by looking at ourselves in the mirror; rather, in diffractive methodologies we perform care by interrogating our reflections for their constitutive exclusions.

Diffractive methodologies subvert the need for explanations of how the thing-we-call-practice relates to the thing-we-call-theory, and vice versa. In collapsing the differentiated notions of ‘practice’ and ‘research’, the notion of practice-as-research simultaneously invites-yet-resists reconciliation between conceptions of research across domains. When the motives and methods of researchers in artistic practice-as-research are defined by the ways in which they do or do not reflect norms in other practices of research, for example in the humanities and sciences, the danger is that unfamiliar and emergent articulations of knowledge may remain unintelligible within foreign frameworks. This concern is not exclusive to the arts; as artist-scholar Simon Jones argues:

[...] the epistemological difficulties inherent in the phrasing of a judgment of practice-as-research are analogous to those encountered by physicists in their attempts to measure the quantum world using the experimental machinery developed to demonstrate Classical or Newtonian mechanics. The aporia between these realities – the everyday and the quantum – challenged the belief that systems could be finally known through measurement. (Jones 2009: 30)

When first conceived by physicist Niels Bohr, the phenomenon that we now call ‘diffraction’ defied explanation in classical physics, demanding new vocabulary, tools, and methods, as well as a shift in frames of reference, to make itself intelligible—not intelligible in-itself, but intelligible as a differentiated phenomenon within the body-of-knowledge of physics. The appropriation of the notion of diffraction from what at this juncture became quantum rather than classical physics, into feminist and queer theory

by Barad and others—as both a metaphor and methodology—has multiplied its effects and affect. If unfamiliar articulations of ‘research’ in artistic practice-as-research are to be sustained as entangled-differentiations with other conceptions of the thing-we-call-research, we need to approach practice-as-research diffractively “so that we get more promising interference patterns” within the ethico-onto-epistemological becomings of transdisciplinary bodies-of-knowledge (Haraway 1997: 16).

Resisting the transposition of disciplinary norms need not be a matter of distancing, othering or critique. In the context of academia researchers we are always-already in contact with multiple disciplinary cultures, and more importantly, implicated in the continual re/configuration of disciplinary boundaries through which particular knowledges become more and less salient—not once and for all, but for here and now. As Barad reminds us: “[d]iffraction is not a singular event that happens in space and time; rather, it is a dynamism that is integral to spacetime-mattering”, an iterative and intra-active affair without a defined beginning or end (2014: 169). No ‘one’ can claim responsibility for diffractive acts, and yet we are always “accountable to the specific materializations of which we are a part” (Barad 2007: 91).

If we desire to make a difference in the world as we see it (vis-à-vis systemic and disciplinary operations of power—which we necessarily cannot see), diffractive methodologies in practice-as-research are one strategy to illuminate the constitutive exclusions that bound (our) bodies-of-knowledge. In bringing light to the ways in which knowledges about bodies are differently constituted for different people to serve different interests in different research contexts, we have an opportunity to confront the

edges of our own frames of reference—beyond which other ways of seeing, saying and doing remain unintelligible and unavailable to us.

Sharing my practice-as-research in the context of my PhD

On the differentiated-yet-entangled ‘parts’ of my practice-as-research

As part of the practice-as-research outcome for my PhD—this thesis being another part—I facilitated an event in collaboration with composer John MacCallum and dancer Laura Boudou, designed for three guests at a time. I hosted this event several times, with my doctoral examiners attending one iteration of the event. The event was comprised of an hour-long workshop on ‘Relational Listening’, followed by a 30-minute performance titled *III: Circulation*. The workshop and performance were conceived as aspects of the same research. In their entangled realization, the workshop and performance examine choreography and composition as the shaping of contexts in which diffractive encounters (may) emerge between performers and visitors with one another, and with a range of sonic, visual, and haptic media. Further, the various stages of the workshop and the distinct sections within the performance are intended as differentiated-yet-entangled articulations of our desire in *III* to bring awareness to one’s own awareness—and to one’s own awareness of one’s own awareness. The technologies we appropriate in this event, from mirrors to click-tracks to transducers to video projection, are a means to intervene in ways of looking, listening, and otherwise sensing and making sense of ‘things’—bodies, breath, movements, sounds, imagery, ideas—in their relational context. The differentiated parts of the workshop and performance resonate throughout these pages, at times by way of explicit reference, but

more profoundly by way of epistemological, ethical and aesthetic undercurrents that traverse my collaborative work in *III*.

The relation of this thesis with the workshop-performance sharing for my PhD is a relationality of “exteriority-within”, such that the differentiated outcomes of my PhD may illuminate “shadows in ‘light’ regions and bright spots in ‘dark’ regions” of their always-already entangled expressions of knowledge (Barad 2007: 135). The value of differentiating articulations of knowledge within my practice-as-research—in the workshop-performance and in this thesis—is that, as “exteriorities-within”, these entangled parts may invite generative destabilization of the implicit value systems that govern the relational intelligibility of ‘things’ within their boundaries. These ‘things’ may include, for example, the thing-we-call-research, within and between disciplinary domains.

In the following sections I provide a brief overview of the practice of ‘Relational Listening’, as well as the performance of *III: Circulation*. Additionally, I identify references to this event, folded into the later chapters of my thesis.

On ‘Relational Listening’

‘Relational Listening’ (RL) is a practice I am developing in collaboration with composer John MacCallum, as well as dancer Laura Boudou. The many dancers and musicians who have participated in extended training with John and I, spanning weeks to months to years, have also contributed greatly to our continually evolving understanding of the practice.

In RL we investigate a seemingly simple task: listening to and relating with a variable click-track. This click-track is a sonified interpretation of the highly variable behaviour of the human heart from beat-to-beat—quite unlike the regularity and predictability of a metronome—and was inspired by our use of ECGs in performance. The challenge for participants, as we listen to this variable click-track, is not to follow, nor to anticipate the pulse. Instead, we ask each person to attend to their unstable temporal relationship with the click-track, such that they have agency to assemble and adapt the rhythmic textures that emerge between their actions and the sound. This training process is highly structured and repetitive, and involves breathing, tapping, weight shifting, and eventually movement and sound exploration, as a means to confront conventions and habits derived from disciplinary training.

Although RL began as a specialised training with dancers and musicians, it has expanded and become more generalized as a practice through which we approach questions about the relational behaviour and boundaries of one's own awareness. We host RL workshops with practitioners from diverse backgrounds (e.g. computer science, human-computer interaction, somatics, philosophy, performance art, architecture), and sessions range in duration from one hour to an entire month. More recently, we began exploring RL as 'warm-up' or entry point into our work for audience-participants, in particular in intimate performances designed for 1-3 guests at a time. In the practice-as-research sharing for my PhD, the emphasis on bringing awareness to the behaviour of one's own awareness, and to distributed awareness, carried from the practice of RL into the performance of *III: Circulation*.

On 'III: Circulation'

III: Circulation is a performance designed for three guests at a time, with three performers—and no ‘outside’ observers—because, for us, everyone and everything involved in the unfolding of the event is integral to the event itself. In my PhD sharing, following the RL workshop I guided each guest to a seat at a private station on the periphery of the space, facing away from the other guests as well as away from the performers. From above each seat, a long panel of white paper curved down to create a surface for projection in front of each guest, as well as a sense of enclosure in the space. Each guest was provided with a handheld mirror which I invited them to use to view the movement of the performers behind them. The sound throughout the piece was generated tactilely, via transducers affixed to the back of each chair, and on the floor, to project sound into the space as well as through each seat.

III: Circulation has three distinct sections. In the opening section, there is video projection on the white panel in front of each guest, while the dancers traverse the space behind and between the stations. With (or without) the use of their handheld mirror, audience-participants piece together discontinuous fragments in the sounds and movements that circulate about them. No one can see or sense everything, and everyone experiences the event from their particular perspective based on the distribution of their own attention. This exaggerates the condition that, as in any performance, spectators must make choices, implicit or explicit, about how they direct their attention in one way rather than another, to certain details at the expense of others.

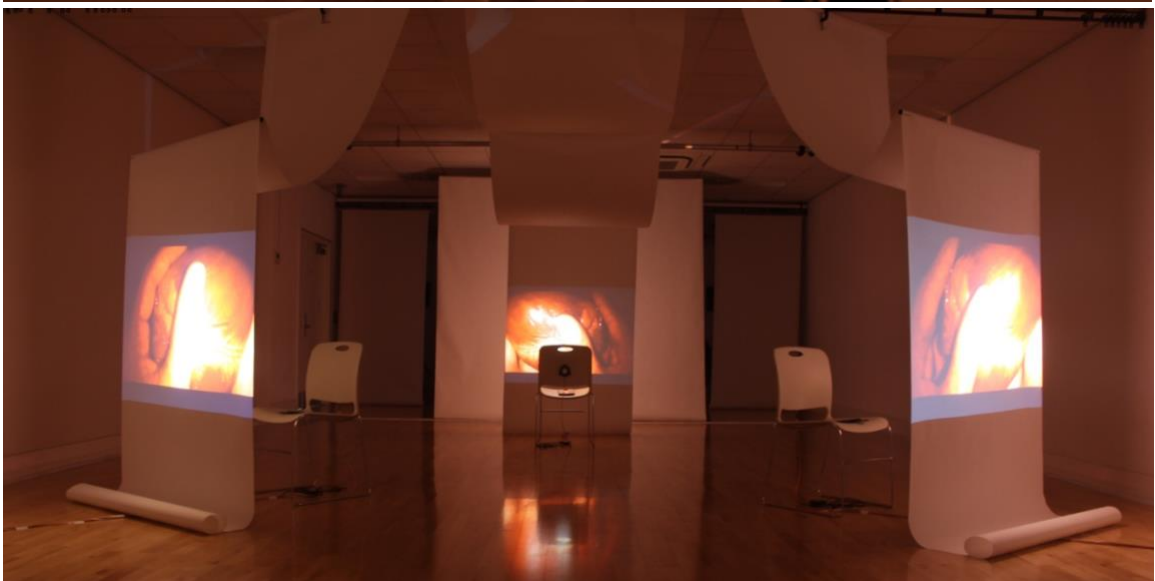


Figures 1-3: Video stills from *III: Circulation* during work-in-progress sharings at the Centre for Dance Research (C-DaRE) at Coventry University, May 2018 © Naccarato and MacCallum 2018

The middle section of *III: Circulation* is in complete blackout, and involves a polytemporal breath composition in which the three performers wear headphones and breathe with the tempo of their own click-track as it arcs gradually from slow deep breathing, to hyperventilation, to a sustained breath hold, and so on. The arc of each click-track is subtly different, producing a dynamic rhythm and texture between the three parts, as well as different patterns of variability in the respective ECG signals. As the breath composition progresses, the audience may see, hear, and sense the effort involved in the breathing for each performer, especially in moments where they begin to struggle to maintain speed and amplitude of breath.

The final section of *III: Circulation* features a video (*III: Cœur de cochon*—to be discussed further in Chapter 4), in which two sets of hands massage the dense musculature of a heart, tracing the markings along its surfaces, as well as entry points into its vessels and chambers. Simultaneously, the ECG signals recorded from each performer in the breath section are played back through the transducers as tactile feedback, echoing the temporal and energetic arc of the breath composition.

Over the course of the two-hour session with visitors, the effects of each part of the performance, as well as the guided listening tasks in the workshop, take effect in relation to each other—and multiply with each other—producing an event that is more than the sum of its parts.



Figures 4-6: *III: Cœur de cochon*, video still and projection in the context of *III: Circulation* © Naccarato and MacCallum 2018

On other traces of the live events in this thesis

Throughout my thesis there are additional references to the workshop/performance event as it relates to my long-term collaborative practice in *III*. For example:

- In Chapter 4, I provide an image and link to the full video of *III: Cœur de cochon*, which was featured as the third section of *III: Circulation*. I also interweave a first-person text derived from my experience of making the film throughout the same chapter, in counterpoint to the discussion of the thing-we-call-the-heart.
- In Chapter 6 I discuss the notion of critical appropriation as it has come to matter in my practice-as-research in *III*, and provide further explanation and contextualization of our practice of Relational Listening.
- Finally, in Chapter 7 I draw on my collaborative writing with John as choreographer-composer (MacCallum and Naccarato 2019), to foreground this text *as* the design of a context for *intra-action* between authors, between authors and readers, and between myriad materials that course through its veins.

More profoundly however, the differentiated parts of the workshop and performance resonate in these pages by way of epistemological, ethical and aesthetic undercurrents that traverse my collaborative work in *III*—without washing over critical differences that come to matter between multi-modal articulations of knowledges *in, of, and about* bodies and movements.

Conclusion

In this chapter I outlined key themes in my long-term, collaborative practice-as-research in *III*, with regard to differentiation, authorship, reflexivity and diffraction. My enacting of multiple, partial framings of my, or rather *our* methodology in *III* overall, and in my PhD specifically, lays the foundation for a discussion of critical appropriation and intra-action—as practices of innovation-by-destabilization—in the later chapters of my thesis. First, however, in the coming two chapters I dive into a deconstructive analysis of the thing-we-call-the-body as well as its heart, parts, and processes, as conceived across research cultures, and over the course of centuries. I do so as a means to incite diffractive encounters between diverse bodies-of-knowledge about bodies and other such ‘things’—things which become intelligible as entangled-differentiations in the context of our performance work, and therefore, subject to our gaze as choreographer-composer.

Chapter 3: The thing-we-call-the-body

Opening Questions: What is this thing-we-call-the-body? Is the human body a thing like other things? Is the dancing body a thing in-itself? In movements such as Cartesianism, phenomenology, structuralism, materialism, constructivism, feminism, and new materialism, how do bodies and other-than-bodies become differentiated, yet remained entangled, within and between disciplinary bodies-of-knowledge?

Introduction

I began writing this book by trying to consider the materiality of the body only to find that the thought of materiality invariably moved me into other domains. I tried to discipline myself to stay on the subject, but found that I could not fix bodies as simple objects of thought. Not only did bodies tend to indicate a world beyond themselves, but this movement beyond their own boundaries, a movement of boundary itself, appeared to be quite central to what bodies “are.” I kept losing track of the subject. I proved resistant to discipline. Inevitably, I began to consider that perhaps this resistance to fixing the subject was essential to the matter at hand. (Butler 1993: viii)

In an attempt to write about the boundaries of the human body, I found myself reading across millennia, and across cultures and disciplines, only to realize that what I had imagined was an ontological question (i.e. what is the body?), was inevitably bound with epistemology, ethics, and aesthetics, making it impossible to fix the subject at hand as a ‘thing’ in-itself. The boundaries of the human body—and by this, I do not necessarily mean the skin—bound a thing that is something, does some things, and means many things to different people in different contexts.

As a contemporary dancer and choreographer, my notions of what bodies *are* and what bodies can *do* inform my craft (implicitly and explicitly) at all stages of research, creation, pedagogy, and performance. Human bodies—my body, a dancer’s body, a musician’s body, the body of each and every audience member and reader—are

entangled with bodies in a broader sense—human and posthuman, material and immaterial, individual, collective, and disciplinary. In my ongoing collaboration with composer John MacCallum in *III* we use ‘sensing technologies’ (e.g. video cameras, microphones, lights, mirrors, and biosensors) to bring attention not to the thing-we-call-the-body *itself*, but rather, to the performative act of examining and representing bodies in performance. Key to our work in *III* is the notion that any act of examining the thing-we-call-the-body (visually, aurally, tactilely, kinaesthetically) is always-already integral to emergent understandings of the boundaries and capacities of this body; in this sense, a body is never a body in-itself (intelligible in-itself), but rather becomes intelligible as a body through its continual, material-discursive differentiation-yet-entanglement with other bodies.

In this chapter I trace entangled understandings of the human body from Cartesianism to phenomenology, and materialism to constructivism, as manifest in different disciplinary cultures over time. I begin by addressing phenomenological and structuralist discourse in dance and somatic practices, as well as attempts to reconcile ‘somatic’ and ‘social’ conceptions of the body in dance scholarship. I then bring into dialogue Tristan Garcia, Judith Butler, Michel Foucault, and Karen Barad, whose work traverses object-oriented-ontology, new materialism, and agential realism—movements integral to questioning the un/becoming of ‘things’, including the thing-we-call-the-body, beyond binary designations. Finally, I consider ways in which conceptions and representations of bodies (human and posthuman, material and discursive, biological and cultural) come to matter only in concert with the relational shaping of contexts in which these articulations of the thing-we-call-the-body resonate. This chapter lays the foundation for

the discussion of the thing-I-call-the-body throughout this thesis, and in my choreographic practice-as-research beyond these pages.

Dancing bodies: From perception to representation

On the phenomenological body (itself) in dance

In contemporary dance, somatic practices, and choreography—my native disciplines—attitudes towards bodies and movement not only reflect but enact value systems through the disciplining and representation of differently constituted bodies and bodily abilities in performance. A wealth of writing about the body in dance draws on ‘phenomenology’, broadly understood as “the study of structures of consciousness as experienced from the first-person point of view” (Smith 2018). Phenomenology involves “the study of ‘phenomena’: appearances of things, or things as they appear in our experience, or the ways we experience things, thus the meanings things have in our experience” (Smith 2018). Phenomenology gained traction as a philosophical movement during the first half of the 20th century through its differentiation-yet-entanglement with the fields of ontology, epistemology, and ethics, and is commonly attributed to philosophers such as Edmund Husserl, Martin Heidegger, Maurice Merleau-Ponty, and Jean-Paul Sartre (Smith 2018). Over the past century debate has persisted regarding the definition of phenomenology as articulated by various philosophers, as well as what characterises phenomenological methods in different disciplinary contexts—including that of dance.

In two substantial books about phenomenology and dance, philosopher Maxine Sheets-Johnstone not only applies phenomenology to dance but uses dance to articulate

phenomenology ([1966]2015, 1999). Following Husserl, Sheets-Johnstone argues that the body, and likewise its movements, are not symbolic or representative of anything outside themselves (e.g. structures, systems, ideas, theories, culture); rather, bodies produce meaning in their own right via *direct* and *immediate* sensing of the world (1999: 491). She proposes that in the case of dance improvisation:

the dance being created is not a dance that the dancer might acknowledge as being “about” something, unless that something were movement itself. [...] The kinetic intelligence that creates the dance informs the dance itself. No more than the dancing body must movement stand for or refer to something beyond itself [...]. To have meaning is not necessarily to refer and neither is it necessarily to have a verbal label. Movement – animation – can be in and of itself meaningful. (Sheets-Johnstone 1999: 491)

What Sheets-Johnstone proposes here is akin to a Husserlian ‘bracketing’ of the world beyond the conscious experience of the individual (be it for the dancer, choreographer, or spectator). This bracketing, also referred to as ‘epoché’ or ‘phenomenological reduction’ in Husserl’s work, is meant to help shed discursive interference in favour of examining perception and consciousness *themselves* (Sheets-Johnstone 1999: 92–93). Sheets-Johnstone argues that “actual experiences of perception—freed “from 20th century scientific explanations of perception”—are “consistently localized” such that seeing takes place in the eyes, hearing in the area of the ears, tasting in the mouth, and touching on the skin (1999: 92–93, orig. italics). She elaborates: “I take in the thisness or whatness, or, in a broad sense, the qualitative significance of a thing without its matter *at the site of the sensory organ itself*” (Sheets-Johnstone 1999: 92–93, orig. italics). Thus, in Sheets-Johnstone’s articulation of bracketing the condition for perceiving things themselves is the erasure, however transient, of the material-discursive context in which perception takes place—that is, beyond the site of “*the sensory organ itself*” (1999: 92–93, orig. italics). In this sense, Sheets-Johnstone

foregrounds sensing *itself* as the means by which movement (in dance and beyond) gains significance in our individual frame of reference.

In contemporary dance and somatic practices this so-called bracketing (of the world) is employed often, at least in moderate forms, to focus awareness on the body and movement *themselves* during training, creation, and performance, without need for explicit interpretation or projection of meaning. In particular, when practitioners desire to identify and intervene in patterns of movement that have become habitual and imperceptible over time the narrow scope of attention implied by phenomenological bracketing can be useful. These patterns may relate to posture, pathways in space, temporal phrasing and rhythm, qualities of movement, or the continual re-distribution of body weight and awareness in a given context. The need for bracketing is articulated (at least implicitly) in guidebooks for somatic practices (e.g. Feldenkrais 1985, 1990, 2010, Alexander 1997, Skinner 1997, Cohen 2012), as well as in numerous articles in the *Journal of Dance and Somatic Practices* (e.g. de Lima 2013, Green 2015, Williamson 2016, and Fraleigh 2017), and likewise in a range of books on dance and phenomenology (e.g. Parviainen 2002, Kozel 2007, Bleeker et al. 2015, Fraleigh 2018, Grant et al. 2019).

The influence of phenomenology in dance is not limited to the notion of bracketing, nor to Husserl's work, and many dance scholars (including those cited above) favour Merleau-Ponty's phenomenology, which foregrounds 'embodied', 'intercorporeal' and 'intersubjective' experiences *in* and *of* the world (Merleau-Ponty [1945]2002). This shift, however, does not overcome the long-standing resonance of bracketing in movement-based practices of research. I am curious about *how*, *why* and *when*

researchers in dance, as well as from other domains which study and represent bodies and movements, choose to engage in this kind of selective awareness of ‘things’ themselves—be it one gesture, one sound, one object, or one body—at the expense of all else, all others?

On the phenomenological body/mind in cognitive science

Philosopher Alva Noë argues that in particular circumstances, especially in the early stages of research, ‘bracketing’ can be effective in that allows one to “undertake a phenomenological investigation without making any empirical or metaphysical assumptions”, thus leaving “open how things are beyond the limits of our consciousness” (2007: 331). He gives the example of a detective gathering “phenomenological data” from a crime scene, not as an end in-itself, but as a starting point for empirical investigation (Noë 2007: 333). Noë argues that what might be considered “pure phenomenology”—i.e. reflective and introspective accounts as an autonomous and isolated approach to research—is exceedingly rare (2007: 233). In addressing the need for first-person methods in cognitive science, Noë advocates for the value of a “moderate” phenomenology in which “phenomenology is a merely descriptive preliminary to theorizing about the nature of consciousness” (2007: 233). Following Lutz & Thompson (2003), Noë notes “that sophisticated subjects – subjects who have been trained to pay attention to their experiences [for example dancers and somatic practitioners] – can collaborate with researchers to advance understanding of the neural basis of experience” (2007: 233–234). Indeed, dancers and choreographers are commonly recruited as experts on ‘embodied’ perception and movement analysis by researchers in domains such as cognitive science, computer science and human-computer interaction; see for example: Subyen et al. (2013), Silang Maranan et al.

(2014), Bevilacqua et al. (2014), Junokas et al. (2015), Fdili Alaoui et al. (2012, 2015a, 2015b), and Piana et al. (2016).

Notably, the phenomenological notion of ‘embodied cognition’, i.e. the “direct *coupling* of perceiving, conceiving, and moving – a coordination unmediated by *descriptors* of associations, laws, or procedures”, has served well in advocacy for dance as a knowledge-producing endeavour—backed by the authority of cognitive, neuro, and computer science (Clancey 1997: 2 orig. italics). In the discourse of embodied cognition, ‘cognition’ is not defined as a function in brain alone; rather, cognition is described as a distributed and relational process in one’s body, mind, and environment. In recent edited volumes focussed on embodied cognition in dance and music (e.g. Bläsing et al. 2010, Shaughnessy 2013, Cox 2016, Kemp and McConachie 2018), the authors advocate for the value of *embodied* and *enactive* approaches to learning and sharing knowledge across disciplines. Noë has also been vocal in this regard, and has published several books (2004, 2009, 2015) that emphasize the inextricable entanglement of action and perception in everything ‘we’ do. The work of philosophers/cognitive linguists Mark Johnson and George Lakoff (1980, 2008) likewise points to the bodily roots of all meaning-making through “structures of organism-environment interactions”—that is, metaphors—which are not mental representations but rather “integrated experiences of meaning” within everyday tasks and artistic practices alike (Johnson 2008: xii–xiii). Philosopher/biologist Francisco Varela contributes to this sentiment further with his explanation of ‘virtuosity’ as an “immediacy of perception and action”, such that the body cannot be understood as a vessel through which meaning flows, or as the servant of a mind localized in the brain (1992: 7, 9); rather, the body itself becomes integral to meaning-making and knowledge

production in endeavours such as dance and choreography through its making and remaking of its own *conscious* world. Noë argues that: “[c]onsciousness is not something that happens inside us. It is something we do or make. Better: it is something we achieve. Consciousness is more like dancing than it is digestion” (2009: xii).

On ‘reading’ bodies in dance: Structuralist perspectives

In structuralist discourse since the mid 20th Century in France, and more broadly to present day in what is characterised as “constructivist structuralism”, the notion of *direct* phenomenological access to knowledge is refuted (Flecha et al. 2001).

Structuralism, in its various forms, posits that our capacity for awareness and consciousness stems from underlying “universal” structures and systems through which things become intelligible to us (Flecha et al. 2001: 33, Lundy 2013: 72). Structuralists argue that it is these underlying structures and systems—rather than an individual’s experience itself—that merits objective and empirical investigation (Flecha et al. 2001: 33, Lundy 2013: 72). Structuralist thinking has been integral to the development and legitimization of the field of dance studies, owing in part to the metaphorical parallel of ‘reading texts’ and ‘reading dancing’ (Foster 1986, Adshead 1988, O’Shea 1998: 6–7). As dance scholar Janet O’Shea emphasizes: “Recourse to structuralist thought allowed dance to establish itself as an autonomous field, demonstrating that dance possessed a legibility that rendered it available to analysis” (1998: 6). To this end, structuralist analysis in dance requires the deconstruction of formal components of the movement and choreography to identify the “dance’s overall patterning and [locate] the dance within larger events” (O’Shea 1998: 4). Contrary to the foregrounding of subjective and situated experience in phenomenological methodologies, structuralist

approaches assume “an overarching vantage point that awards the author a totalizing and objective view” (O’Shea 1998: 4).

Importantly, adopting a purely structuralist or purely phenomenological lens is not possible, and the bleeding of supposedly objective and subjective perspectives into one another is inevitable. In a sense, structuralist analysis in dance addresses a similar problem to phenomenological analysis, namely: the relation of the ‘self’ (in terms of perception, experience, and consciousness) and the ‘world’ (everything else). In each case, however, the arrows of causality between self and world are reversed—*without addressing how the self and world became distinct things with the capacity to act in or on the other in the first place*. Whereas phenomenology as an ‘autonomous’ practice purports to study the world from the subjective perspective of the individual, structuralism and its close allies constructivism and positivism examine the individual from the supposedly objective perspective of the world. Whereas phenomenology refutes the idea that the human body represents anything outside itself, structuralists examine the body as a reflection and expression of cultural systems and structures. Although phenomenology and structuralism may be imagined as oppositional ideologies, they are bound in their shared assumption of an implicit division between the self and the world as the starting point from which they are needed to explain this relation. Without this shared, foundational assumption—that is, that ‘the self’ and ‘the world’ precede their *intra-actions*—the need for either ideology comes into question.

On the entanglement of bodies in phenomenological and Cartesian discourse

What are the roots of the assumption that the self and the world, and likewise the mind and the body, are separate ‘things that interact’ with one another in ways that we must

explain or that we may even control? Philosophical dualism is commonly attributed to the work of René Descartes in the 17th century, whose influential doctrine has become known as Cartesianism. For Descartes, disentangling mortal matter from the spiritual expression of the soul was of utmost importance, as a means to reconcile scientific reason with his Catholic faith. Descartes was vigilant in his distrust of sensory perception, borne of the flesh:

I will suppose then, that everything I see is spurious. I will believe that my memory tells me lies, and that none of the things that it reports ever happened. I have no senses. Body, shape, extension, movement and place are chimeras. So what remains true? Perhaps just the one fact that nothing is certain. (Descartes 1641: 16)

In his ‘Objections and Replies’ to the *Meditations*, Descartes elaborates on the relation of the senses to the conscious mind, stating that:

Although there is deception or falsity, it is not to be found in the senses; for the senses are quite passive and report only appearances, which must appear in the way they do owing to their causes. The error or falsity is in the judgement of the mind [...]. Nevertheless, when deception occurs, we must not deny that it exists; the only difficulty is whether it occurs all the time, thus making it impossible for us ever to be sure of the truth of anything which we perceive by the senses. (Descartes 1641: 63)

Importantly, the skepticism expressed by Descartes must be understood contextually in the era during which he lived, i.e. before the rise of Cartesian dualism and before Husserl’s phenomenology in the early 20th century (Bordo 1987: 34). Susan R. Bordo proposes that Descartes’ practice of first-person intentionality in the *Meditations* “may be understood, loosely, as a ‘phenomenology’ of Cartesian skepticism” (1987: 34). She takes note of “how unresolute a mode of inquiry they embody: the dizzying vacillations, the constant questioning of the self, the determination, if only temporary, to stay *within* confusion and contradiction, to favor interior movement rather than clarity and resolve” (Bordo 1987: 14, orig. italics). And yet, the “model of knowledge that

Descartes bequeathed to modern science [...] is based on clarity, certainty, and detachment” (Bordo 1987: 14). Reframing the *Meditations* as a “‘phenomenology’ of Cartesian scepticism” brings into question oppositional accounts of Cartesianism versus phenomenology, as well as the ways in which these ideologies have become associated with practices of objectivity in the *hard* sciences versus subjectivity in the *soft* research of the arts and humanities.

On social/somatic bodies dance

Despite its prevalence, phenomenology is not embraced without reservation in dance and somatic practices. Dance scholars have expressed concern regarding the limits of phenomenology with regard to articulations of the body beyond the individual subject, that is, in relation to social and cultural movements. See for example Issue 9.1 of the *Journal of Dance and Somatic Practices* entitled “Bodily Undoing: Somatics as Practices of Critique” which advocates, overall, for a deconstructive approach to somatic training and scholarship (Alexander and Kampe 2017). In the “Editorial” for this issue, Kirsty Alexander and Thomas Kampe “recognize somatic practices as processes of undoing existing patterns so new ones may emerge”, and ask: “[h]ow can this undoing be extended beyond the body of the individual to the body politic or the social body?” (2017). The editors point to the *Nanopolitics Handbook* as a critical example of collective, artistic re-imaginings of the thing-we-call-the-body in phenomenological and somatic discourse—without recourse to bracketing out the social and political world (Alexander and Kampe 2017). *The Nanopolitics Group* argues that the human body is always-already implicated in political discourse beyond its bounds, by virtue of its capacity to affect and be affected; as such, they ask: “Can an undoing and reshaping of our bodies have an impact on an undoing and reshaping of our

subjectivities and of our institutions?” (2013: 25–28). The various authors in the journal issue and handbook express an urgent need to reconfigure conceptions and representations of bodies not in terms of causality between internal/external, biological/cultural, or somatic/social forces, but rather by deconstructing the processes through which these dichotomies are sustained—in some cases over the course of millennia.

This later point, that is, care for the ways in which dichotomies are continually enacted, is key in interrogating the ongoing effects of differentiation (rather than pre-constituted difference) between perspectives. This is relevant not only with regard to individual perspectives, but also between entire schools of thought like phenomenology, structuralism, constructivism, positivism, poststructuralism, materialism, and new materialism.

On new things in/as new worlds

If we move away from the question difference *itself*, that is, of what one might perceive as fundamentally different about attitudes towards the thing-we-call-the-body in one discourse or another, we can have a conversation regarding the continual processes of entangled-differentiation through which ideologies become differently constituted.

From the mid 20th century to present day, the persistence of Cartesian doubt regarding the veracity of sensory perception—through which things become intelligible as things—need not be positioned in opposition to phenomenological insistence on the primacy of embodiment in the production of consciousness. Discussing the radical orientation of both Descartes and Husserl towards ontological uncertainty, philosopher Paul S. MacDonald argues that:

Both Descartes and Husserl envision an overall response to the sceptical challenge as a demand to renovate the principles under which claims to ‘scientific’ knowledge are made at all. For each thinker this involves demolishing a false picture or model of what a scientific theory of the world would seem to require a mind to be: for Descartes the mind was another ‘object,’ but of a unique kind; for Husserl, the mind could never be another kind of object encountered in the world. Their radicalization of pregiven structures of scientific knowledge disclosed an entirely new world [...] not simply a new way of looking at an old problem, or new terms for expressing an accepted distinction, but rather an entirely new philosophical discourse in which that problem or that distinction can be articulated. (MacDonald 1999: 8)

Only through these emergent contexts, i.e. new worlds, could Descartes’ and Husserl’s material-discursive conceptions of bodies (and minds) become salient. If and when conceptions of things like bodies, brains, minds, hearts, souls, and selves, as well as the notions of life and death themselves, stretch beyond the boundaries of existent discourse, they may become unrecognizable as things that matter within our frame of reference.

As a dancer and choreographer, I am curious about conceptions and representations of the thing-we-call-the-body because bodies are integral to everything I make. My choreography involves the crafting of ‘new worlds’ in which particular things-we-call-bodies can ‘make sense’ and ‘be made sense of’. By examining bodies (of dancers, of makers, of work, of knowledge) in this chapter and this thesis overall, I shape contexts in which the perceived boundaries of bodies (varied in materiality and scale) may become vulnerable to destabilization via contact with ‘foreign’ bodies. Interrogating the ongoing re/configuration of bodily boundaries is of interest to me because it illuminates the constitutive exclusions through which *one* body becomes differentiated from any *other* body—and owing to this differentiation, becomes intelligible as a body that *matters*.

Un/becoming bodies: Differentiating ‘things’

So far in this chapter I have discussed the thing-we-call-the-body in the entangled ideologies of phenomenology, structuralism, and Cartesianism, as they pertain to dance and somatic practices. In the coming section, I look more abstractly at the notion of ‘the body’ in poststructuralist and feminist discourse, and address the ways in which the boundaries of individual ‘things’ (be it *one* body, movement, gesture, object, or concept) become differentiated from other such things. The ongoing differentiation between things and their parts is only possible within differentiated-yet-entangled frames of reference—frames which are always-already personal, political, disciplinary, and cultural. I raise the concept of ‘things’ here as a means to interrogate the limits of intelligibility of particular things, for particular people, in particular contexts.

I will begin with a deceptively simple question: *is the human body a thing?*

On bodies and other such ‘things’

In *Form and Object: A Treatise on Things*, philosopher Tristan Garcia argues that in contemporary colloquial use the notion of ‘thing’ is understood as that “which obtains its unity in a part of matter”, “which has some coherent qualities”, and which “can then undergo spatio-temporal displacements and transformations without its identity being altogether affected by them” (2014: 34). For example, a human body changes in form from infancy to old age, but may be considered to be the same self-identical thing (Garcia 2014: 34). I wonder, however, just how much change can a particular thing-we-call-a-body, for example, *my* body, undergo before it is no longer identifiable as the same self-identical thing?

Let us imagine that over the course of my life, each and every part of my material body is removed and replaced—amputating and substituting my arms, legs, and joints for prostheses; transplanting my heart, lungs, gut, cornea, skin, and even brain for those of another; transfusing my red blood cells, platelets, and plasma. At the end of this ordeal, is my body still *mine*? Is it the same self-identical thing?⁵

Now, what if I were able to reverse this process, piecing my ‘original’ body back together again? My blood in my veins in my heart in my chest beneath my skin... with my brain... mine, again. Is this re/incarnated body—by way of radical surgical intervention—more or less ‘authentic’ than the previous two?

Surely each iteration of my body invoked here—the original, the prosthetic, and the reincarnate—constitutes “a collection of matter which has some coherent qualities” and which can “undergo spatio-temporal displacements and transformations without its identity being altogether affected by them” (Garica 2014: 34). And yet, these imagined bodies as ‘things’ cannot be understood as things in-themselves; even my so-called ‘original’ body can only be judged as original through its continual differentiation from all other past and possible bodily becomings. So the question remains: how much can a given thing diverge from normative conceptions of its identity for particular people in particular places, before it is no longer identifiable as the *same* thing?

Elaborating his notion of ‘things’ in relation to bodies, Garcia argues that although for each thing-we-call-a-body “a coherence exists – a series of relations that connect this

⁵ Here I repurpose the thought experiment known as the ‘Ship of Theseus’, or ‘Theseus’s paradox’. For an explanation of the original thought experiment, see Wasserman (2018).

human being's bodily limbs, tissues, and functions to a biological and physical interdependence identifying this material thing as an organism", a human body or being can never be or become a thing *in-itself* (2014: 54). For Garcia, the ontology of each and every 'thing', including human bodies and beings, is inherently relational, such that:

[...] a human being is one human being only insofar as it counts among human beings. Unity is primarily the possibility of being counted, of entering into the count. To be one is to be capable of being one of two, three, ten, and so on. To be one is to be capable of acting as a unity in the counting of that which one is, since one is one something. (Garcia 2014: 54)

Things become identifiable as things in the world—that is, in our world—via “a circulation of being that systematically distinguishes two senses [...] of things: *that which is in a thing* and *that in which a thing is*, or that which it comprehends and that which comprehends it” (Garcia 2014: 11, orig. italics). Put another way: “what is in the world is not identity but difference, trajectory, becoming, a continuous projection of being which never leads to a compact being. [...] There is no in-itself” (Garcia 2014: 10). Things, such as bodies, or gestures, or genders, become intelligible within one's frame of reference only through their differentiation from other such things—things which they are not, or at least, things which they are no longer. *Things which do not become differentiated for us, remain imperceptible to us.*

Importantly, differentiation does not produce difference in an absolute or binary sense. To become differentiated is to remain always-already in the process of differentiation, through which things become intelligible as particular things for particular people in particular contexts. My body remains *mine*, and constitutes my 'self', in as much as it remains countable among other bodies and other selves.

On determining ‘things’

The determination that my body is indeed mine, and not yours, or theirs, or even another iteration of itself, requires a preconception not only of what my body is, but of how it came to be so. From materialism to constructivism, beliefs about the ways in which human bodies become discrete ‘things’ diverge. The debate, reduced to its basic form, goes something like this: are bodies simply things made up of their biological components (flesh, bones, blood, all bound beneath the skin and governed by physiological systems)? Or, are bodies a product of cultural inscription (i.e. blank slates onto which culture ‘writes’, and subsequently ‘reads’ meaning)? Put another way, are bodies biologically or socially determined? For materialists, the body is a thing in-itself, distinct from all other things through its tangible physical boundary, the skin. All that a body is, and all that a body does, can be understood through an examination of its materiality. For constructivists, the actual matter of an individual body is secondary to the social and cultural norms that shape its abilities and behaviours from without; in this sense, the constructed body is never a thing in-itself, but rather, internalizes the effects of other things that act upon it. Of course, some people believe that bodies are both biologically and socially determined—but determined, nonetheless.

While materialists may readily refer to a body as a thing, constructivists may resist the objectifying ring of this classification. Understandings of the body as object or subject, passive or active, and natural or artificial are but a few of the binary designations that accompany the debate between materialism and constructivism. Referring to the human body as a thing may trouble some people, because it positions the body in relation to other animate and inanimate things without first granting it unique status. Garcia acknowledges that:

Some think that a person must not be reducible to a thing. [...] Not only do persons appear to have spatio-temporal identity, but also, in most cases, an experiential and conscious identity, namely by relating – through sensation, cognition, language, or memory – to itself as to something self-identical. Some normally think that a person is actually a bit more than a thing. (2014: 34)

For those who believe that human beings cannot be reduced to mere things, but rather, constitute a bit more than things, several ethical questions must follow; for example: can all people be said to be equally ‘more than a thing’? Does the ability to relate to oneself (through sensing, thinking, verbalizing, remembering) produce an ‘experiential and conscious identity’ that elevates human beings above other things in the world? If so, is one human being equivalent to one of something other than a human being? If not, how do we count, and be accountable for ourselves and our other-than-selves?

Attempts to determine the ontological status of the human body as a biological/social thing—or more than thing—in relation to other things, are inevitably bound with how one comes to know, and why one desires to know (about) this thing. For Garcia, the relational ontology of all things means that particular things become intelligible to us as one-such-thing through their differentiation, or ‘reification’ from others within our frame of reference. He states:

Reification – the reduction of our world to a world of things – is not an evil, the dehumanisation, desensitisation, or disenchantment of the world, but the precondition of a human understanding of the differences between things. A system of exceptions in the world of things is never an ‘ethical’ or ‘just’ system, but rather a metaphysical system of the determination of inequalities between things, of ‘more-than-things’, which cannot be elements of this system. (Garcia 2014: 29)

As inequalities between ‘things’ and ‘more-than-things’ emerge within our frame of reference—not once and for all, but for here and now—our frame of reference itself becomes reified as a frame among frames. Our ways of seeing, listening, touching, and

otherwise making sense in and of the world are inherently entangled with other ways of making sense, enacting the boundaries of our bodies-of-knowledge as sites of ethical differentiation and potential transgression. Through the entangled-differentiation of ourselves from other selves as ‘things’ in the world, our selves become subject to reification by other potential selves. As Garcia puts it:

Something other than themselves always reified them, exposing their limits, determinations, and particularities, before subsequently reducing them to the rank of a particular thing, in an infernal chaos of thought. Everything that made things was made a thing, as if the executioner was condemned to be executed by an executioner, forced to be subjected to the same fate. (Garcia 2014: 33)

The key point I want to make here, is that for one thing to be considered a thing called a human body, other things must be excluded from this category—and this act of exclusion has consequences, for everything and everyone involved.

Having brought into question the ontological status of the thing-we-call-the-body from the vantage points of materialism and constructivism, and more profoundly in Garcia’s articulation of object-oriented ontology, I now turn to Butler, Foucault, and Barad to address the ethical and power-laden constitution of bodies *within* and *as* bodies-of-knowledge.

On the haunted boundaries of bodies

In *Bodies that matter: On the discursive limits of sex*, gender theorist and philosopher Judith Butler proposes that “thinking the body as constructed demands a rethinking of the meaning of construction itself” (1993: x). Departing from constructivism, without abandoning it altogether, Butler points out that to claim that bodies, and likewise gender, are constructed, suggests that there is an “‘I’ or a ‘we’ who enacts or performs that construction” without first being subjected to construction itself; on the contrary: “it

is unclear that there can be an 'I' or a 'we' who has not been submitted, subjected to [...] the differentiating relations by which speaking subjects come into being" (Butler 1993: xvi). Butler warns us that:

it is not enough to claim that human subjects are constructed, for the construction of the human is a differential operation that produces the more and the less "human", the inhuman, the humanly unthinkable. These excluded sites come to bound the "human" as its constitutive outside, and to haunt those boundaries as the persistent possibility of their disruption and rearticulation. (Butler 1993: xvii)

For Butler, the domain of the human and the domain of the inhuman, each produced through differentiation, are not opposites in a binary sense; "oppositions are, after all, part of intelligibility; the latter [nonhuman] is the excluded and illegible domain that haunts the former domain [human] as the spectre of its own impossibility, the very limit to intelligibility, its constitutive outside" (1993: x). Rather than figuring construction as a determinative force that acts upon materiality, construction may also be understood as a relational process of materialization through which boundaries are enacted, but also disrupted and rearticulated. In this sense, bodies (and other such things), cannot be said to be only material or only constructed, nor the outcome of an additive operation thereof which could subsequently be reversed to distinguish the effects of the biological versus the social. For Butler, "what constitutes the fixity of the body, its contours, its movements, will be fully material, but materiality will be rethought as the effect of power, as power's most productive effect" (1993: xii). The effects of power act *through* and *as* "the norms by which the 'one' becomes viable at all, that which qualifies a body for life within the domain of cultural intelligibility" (Butler 1993: xii).

Butler's thinking on the role of power in relation to gender and sex is entangled with Foucault's notion of disciplinary power. In Foucault's articulation, disciplinary power

does not act via direct constraint or prohibition; rather, disciplinary power operates through multiple, internalized practices of self-surveillance and self-regulation, which come to form particular types of bodies, desires, and capacities for action (Foucault 1975: 170). In his own words: “Discipline makes individuals; it is the specific technique of a power that regards individuals both as objects and as instruments of its exercise” (Foucault 1975: 170, orig. italics). In this sense, the effects of disciplinary power may manifest *in* and *as* thoughts, actions, habits and attitudes in ways which appear natural and automatic.

Foucault’s articulation of disciplinary power has encountered some resistance from feminist theorists even as it remains integral to their deconstructive methods; the concern is that his framing of power implies the existence of a stable body prior to internalized cultural norms—a body, that is, that must be “destroyed and transfigured” time and again by “history as a relentless writing instrument” (Butler 1990: 177). Butler challenges the notion of internalization by pointing out that references to “‘inner’ and ‘outer’ make sense only with regard to a mediating boundary that strives for stability”, and emphasizes that:

The critical question is not *how* did that identity become *internalized*? as if internalization were a process or a mechanism that might be descriptively reconstructed. Rather, the question is: From what strategic position in public discourse and for what reasons has the trope of interiority and the disjunctive binary of inner/outer taken hold? In what language is ‘inner space’ figured? What kind of figuration is it, and through what figure of the body is it signified? How does a body figure on its surface the very invisibility of its hidden depth? (Butler 1990: 182-183, orig. italics)

In *The History of Sexuality* (vol. 1), Foucault is explicit that disciplinary power is *not* a force by which bodies become inscribed or even effaced from without. He states to the

contrary that: “deployments of power are directly connected to the body—to bodies, functions, physiological processes, sensations, and pleasures” which become

visible through an analysis in which the biological and the historical are not consecutive to one another [...] but are bound together in an increasingly complex fashion in accordance with the development of the modern technologies of power that take life as their objective. (Foucault 1978: 151–152)

Furthermore, in his late work Foucault elaborated on the notion of disciplinary power to address “technologies of the self”, that is, “how an individual acts upon himself in the technology of self” (Foucault et al. 1988: 19). Misinterpretations of disciplinary power as a reassertion of constructivism often do not take into account Foucault’s later work in which he responded to these concerns.

On ‘thingification’ and exteriorities-within

Entering into dialogue with Butler and Foucault on the topic of materialism and constructivism, Barad challenges aspects of both of their work. With regard to Butler’s discussion of material bodies, Barad cautions that:

Theories that focus exclusively on the materialization of “human” bodies miss the crucial point that the very practices by which the differential boundaries of the “human” and the “nonhuman” are drawn are always already implicated in particular materializations. The differential constitution of the “human” (“nonhuman”) is always accompanied by particular exclusions and always open to contestation. (Barad 2003: 824)

Turning to Foucault, Barad argues that while he addresses the materiality of bodies as “the site where the large-scale organization of power links up with local practices”, he fails to articulate how “the biological and the historical are ‘bound together’ such that one is not consecutive to the other”, and such that “materiality plays an active role in the workings of power” (2003: 809). Barad asks after the historicity of materiality itself in the workings of power, and cautions that to “restrict power’s productivity to the limited

domain of the ‘social,’ for example, or to figure matter as merely an end product rather than an active factor in further materializations, is to cheat matter out of the fullness of its capacity” (2003: 810).

In the hopes of moving “beyond the well-worn debates that pit constructivism against realism, agency against structure, and idealism against materialism”, Barad proposes a philosophical framework that she coins ‘agential realism’ as key to the “rethinking of fundamental concepts that support such binary thinking” (2007: 26). Agential realism assumes that ‘things’ such as bodies (human and nonhuman) are themselves ‘entangled-differentiations’ (Barad 2003: 33). Barad refers to entangled-differentiations (including bodies) as ‘phenomena’, rather than ‘things’, in order to emphasize their relational ontologies and agencies. In Barad’s estimation:

Thingification—the turning of relations into “things,” “entities,” “relata”—infects much of the way we understand the world and our relationship to it. Why do we think that the existence of relations requires relata? Does the persistent distrust of nature, materiality, and the body that pervades much of contemporary theorizing and a sizable amount of the history of Western thought feed off of this cultural proclivity? [...] On an agential realist account, it is once again possible to acknowledge nature, the body, and materiality in the fullness of their becoming without resorting to the optics of transparency or opacity, the geometries of absolute exteriority or interiority, and the theorization of the human as either pure cause or pure effect while at the same time remaining resolutely accountable for the role “we” play in the intertwined practices of knowing and becoming. (Barad 2003: 812)

Remaining accountable for the role that we play in the intra-active production of knowledges requires attention to “the exclusionary practices of mattering through which intelligibility and materiality are constituted”, and recognition that “outside of particular agential intra-actions, ‘words’ and ‘things’ are indeterminate” (Barad 2003: 820). As such, “the notions of materiality and discursivity must be reworked in a way that acknowledges their mutual entailment” (Barad 2003: 820).

Barad's conception of 'phenomena' is not dissimilar to Garcia's reclaiming of 'things' as dynamic relational ontologies—human and nonhuman, yet non-binary—involving the continual enactment of boundaries as the basis for intelligibility in the world.

Revisiting Garcia's conception of 'things': a "thing is nothing other than the difference between *that which is in this thing and this in which this thing is*. Unless one guarantees this double sense, there are no thinkable things" (2014: 13, orig. italics). He goes on to argue that:

Every reductionist who claims to deduce that which this or that thing is from that which composes this or that thing only succeeds in dissolving the very thing that they claim to account for. We attempt to accomplish the exact opposite of this: to guarantee things as invaluable differences embedded in the distribution channels of being of the world. To complete our task, we set out to discover the meaning which circulates among things, between that which composes them and that which they compose, inside or outside us, with or without us. (Garcia 2014: 13)

Although their philosophies and vocabularies are distinct, Garcia and Barad seem aligned in their advocacy for non-anthropocentric and non-representationalist accounts of the entanglement of matter and meaning in the world. Both Barad and Garcia bind ontology, epistemology, and ethics in their analyses, and seek a theory of difference that accounts for differentiation as a matter of entangled agencies between subject and object, human and nonhuman. Garcia's 'double sense' of "*that which is in this thing and this in which this thing is*" (2014: 13, orig. italics), can be related to Barad's emphasis on "exteriority-within-phenomena" (2007: 139-140). Foucault, meanwhile, accounts for this 'double sense' through genealogical analyses of the disciplinary effects of power in/as the individual and the institution (1984), while Butler mobilizes 'gender performativity' as a means to deconstruct binary interpretations of materiality and

discursivity (2008). Importantly, the work of all four authors reminds us that difference is never external or absolute.

In bringing together Garcia, Butler, Foucault, and Barad, my account of their shared desire to trouble dichotomies—human/nonhuman, self/other, male/female, matter/meaning, nature/culture, cause/effect, internal/external—has engendered entangled-differentiations between their articulations of entanglement and differentiation. Why these four authors? Of interest to me, is the globally aligned yet locally divergent knowledges they cultivate concerning the enactment of boundaries, and the intelligibility of bodies. Of significance across their works, is emphasis on the indivisibility of ontology, epistemology, and ethics, albeit expressed in different terms. Reading these authors together helps to illuminate the constitutive exclusions through which they each devise a context in which their articulations gain significance. In my selection and presentation of these authors, I have devised just such a context—the boundaries of which will continue to be reconfigured as I fold additional voices into the body of my thesis.

Conclusion

The boundaries of the human body are an age-old and mutable site in which lovers such as phenomenology and structuralism, and materialism and constructivism, remain forever and always-already entangled. While contemporary texts may frame philosophies within “‘modernity,’ ‘the scientific paradigm,’ ‘the Cartesian model,’ [and ‘phenomenology’] as discrete, contained, historical entities about which coherent ‘closing’ narratives can be told”, investigating the effects of such movements across cultures and disciplines over time points to their continual differentiation, and potential

destabilization with regard to understandings of bodies, and bodily parts and conditions (Bordo 1987: 2). Bodies-of-knowledge must be interrogated not only for the knowledges they make intelligible, but also for the ways in which they constrain the production and distributed activity of other articulations of knowledge over the course of epochs.

In this chapter I examined ways in which bodies and other-than-bodies become differentiated, yet remain entangled, within and between bodies-of-knowledge. While the scope of my examination of the thing-we-call-the-body was broad, traversing various schools of thought since the early 20th century, it was not without requisite, constitutive exclusions. These exclusions relate not only to the absence of particular authors and texts, but also, to the omission of entire disciplinary and cultural discourses concerning the body. Even in the case of authors I gave a central position in this chapter, my transplantation of their voices and views into the foreign body of this text enacted a fundamental shift to their relational significance. These exclusions, in breadth and in depth, are ‘constitutive’ in that they come to form the exterior boundary of knowledges-of-bodies in this chapter—and to haunt this boundary “as the persistent possibility of [its] disruption and rearticulation” (Butler 1993: 8). Re/articulations and re/configurations of the thing-we-call-the-body involve the folding of knowledges into one another over time, such that knowledges-of-bodies within bodies-of-knowledge become ‘ghostly’. Speaking on the entangled temporalities of knowledges, Barad argues that:

The trace of all reconfigurings are written into the enfolded materialisations of what was/is to-come. Time can’t be fixed. To address the past (and future), to speak with ghosts, is not to entertain or reconstruct some narrative of the way it was, but to respond, to be responsible, to take responsibility for that which we

inherit (from the past and the future), for the entangled relationalities of inheritance that ‘we’ *are* [...]. (Barad 2010: 264, orig. italics)

Moving forward “(from the past and the future)”, I fold my concerns about the (haunted) thing-we-call-the-body into my concerns about the (haunted) thing-we-call-the-heart. In the course of my thesis, the role of this chapter and the next is to trouble assumptions of originary and binary difference between pre-constituted ‘things’, in favour of an interrogation of the processes of entangled-differentiation through which such things (e.g. bodies, hearts, brains, minds, souls) come to matter in particular worlds, for particular people, in particular ways.

Chapter 4: The thing-we-call-the-heart

Opening Questions: What is this thing-we-call-the-heart? From antiquity to present day, how has human anatomical dissection and transplantation contributed to understandings of the human heart in relation to the human body, brain, and soul—in life and death? How can an examination of the ontological multiplicity of the heart point to entangled ethical and aesthetic concerns in medical and artistic research alike?

Introduction

We are not meant to touch hearts. Hearts are away, hidden, at the centre where they can't be got at. Protected. Vital. The seat of the soul. If a heart is touched, it can only be a miracle. When Christ's heart appears to a medieval saint, when the heart of a miser is touched with mercy, when a surgeon opens a ribcage and mends a heart, it is a miracle. Otherwise do not touch. (Young 2002: xx)



Figure 7: *III: Cœur de cochon*, video still, full video available at: www.iii-iii-iii.org/portfolio/iii-coeurdecochon © Naccarato and MacCallum 2018.

It is exceedingly rare to hold a beating heart in your hands. And yet, we sense the behaviour of this thing-we-call-the-heart daily. In a moment of panic or fear, we may feel our heart pounding in our chest. Lying in bed, we can probe for our pulse, or place an ear to our partner's chest. With a stethoscope, we can hear the unmistakable *lubdub*, accompanied by a mix of respiratory and fluid passages. Medical imaging with computed tomography (CT) and magnetic resonance imaging (MRI) scans allow us to visualize the heart. We infer the rhythmic activity of the heart by analysing the voltage differential of electrocardiograms (ECGs). Increasingly, heart rate sensors are available in devices such as smart phones, watches, and wrist bands, enabling self-tracking to support health and fitness goals.⁶ Biosensors are frequently appropriated into music, dance, and interaction design to produce representations of the interior workings of the human heart and body in live performance via sonification and visualization, and as a means of biofeedback or biocontrol. It would appear that we are closer than ever to laying bare the secrets of the human heart—to pinpointing what makes it tick, to taming its wild side—but, despite all we can see and say about the heart, with and without biosensors, is it really the heart, per se, we are grasping? What is the heart, *itself*?

In this chapter, I discuss the thing-we-call-the-heart, echoing ethico-onto-epistemological and aesthetic concerns raised in the previous chapter with regard to the thing-we-call-the-body. In focusing on conceptions of the human heart from antiquity to present day, I place emphasis on the ways in which beliefs about the materiality of the heart intersect with attitudes towards human dissection and anatomical knowledge of

⁶ See, for example, the popularity of self-tracking with biosensors in the 'Quantified Self Movement' (Zimmerman 2014, Lupton 2016).

the body. I bring into dialogue interpretations of the material and symbolic significance of the human heart and body in relation to the brain, the self, and the soul—matters of great significance in the event of human to human heart transplants. Finally, I explore how interpretations of the thing-we-call-the-heart have endured, to varying degrees, from ancient Egypt and Greece, into contemporary Western medicine, philosophy, and art. My use of the human heart as a point of departure, as opposed to another organ, or the entire body, is owing to its emblematic weight across cultures, and over centuries—as well as its relevance in my own collaborative practice-as-research in *III*. In appropriating narratives regarding beliefs about the human heart, brain, body, and soul from antiquity to present day—illuminated through acts of dissection and transplantation—my goal is to set the scene for diffractive encounters between bodies-of-knowledge.

Let us now depart, with a failed attempt to capture the heart.

The uncertainty of the human heart, in life and death

On this heart, that heart, and other-than-heart

The first time I ever held a heart was in the making of *III: Cœur de Cochon*. It was a pig's heart. In its dissected form, cut off from the circulatory and nervous systems, this heart could no longer flutter, skip, race, sink, bleed, or desire; it could no longer be brave or courageous; it could no longer be broken. This heart, removed from its body, ceased to look, feel, smell and act as it had as part of the life-sustaining systems of the self—the pig's self, that is. This heart, unlike my heart, could no longer circulate, promiscuously, beneath and beyond the skin. Much of what made it *it*—its movement, its rhythm, its electricity—was no longer. Removed from the body, this chunk of meat,

of muscle, of material, became readily available to my touch and gaze, hinting at its prior life yet refusing to tell all. *This* heart was *that* heart and now it is *another* heart—or perhaps, *other-than-heart*.

Attempts to determine the ontological status of the heart as a biological/social ‘thing’ are inevitably bound with how one comes to know, and why one desires to know (about) this thing-we-call-the-heart. The physical heart, i.e. the organ, can only produce the effects by which we sense its behaviour beneath our skin when it is attached to, yet distinguished from other parts of the body (e.g. the things-we-call-the-vessels, -lungs, and -brain), and given the differentiated operations of the things-we-call-the-circulatory, -vascular, -nervous, and -endocrine systems. Each anatomical part and each physiological system in the body becomes identifiable as such for particular researchers via differentiation from all other parts and systems. One part or one system becomes discrete only in as much as it is countable as one such part or one such system among other such parts and other such systems.

But how does the *one* part-we-call-the-heart become countable as such? How does the heart *itself* as defined in the practices of dissection and transplantation become differentiated, yet remain entangled, with all that is other-than-heart? Physician

Jonathan Miller argues that:

The visible *thisness* of the heart is not quite so clear-cut as one might imagine. It certainly has distinguishable contours, and abrupt changes of colour – and there would be an extra incentive for regarding that patch of the body as a separate thing if it happened to be independently movable as well. The thing we now call ‘the heart’ is distinctly beefier than those pink spongy things that seem to fall back from it on either side when the chest is opened. That, at least, is grounds for labelling it ‘the heart,’ and those ‘the lungs.’ On the other hand, the heart and lungs are tethered to one another by tubes and membranes, and unless you already had a theory that insisted that there was a significant difference between

the object you wanted to pluck out of the chest and all those pink tubes that prevented you from doing so, there would be no particular reason for labelling this ‘the heart’ and those things its ‘vessels.’ Anatomical textbooks give the misleading impression that everything in the chest is immediately distinguishable. (Miller 2007: 42, orig. italics)

Given how messy and interconnected it is inside a dissected chest, why do anatomical textbooks present such clean maps? What values does this setting apart of individual, anatomical territories denote? Moreover, how do separate things inside the mess of a dissected chest become distinguished for us—become countable by us? Miller continues on, stating that: “A practiced eye can readily recognise the gristly pallor of an artery as opposed to the purple flabbiness of a vein, but what *makes* the eye practiced are the theories or presuppositions that direct its gaze” (2007: 42, orig. italics). In order to account for each and every heart, we must learn how to see and to say what the heart itself *is*, as well as what the heart itself *is not*.

This heart is *this* heart and not *that* heart—or *other-than-heart*—because it is a heart among hearts, countable as *one* thing-we-call-a-heart. One heart that flutters, skips, races, sinks, bleeds, and desires. One heart that is brave or courageous. One heart that may get broken, time and again. One heart that belongs to one person—but which may at some point belong to another.

When we were finished with it, we could not bring ourselves to throw it in the trash. Instead, we climbed a high cliff at sunset overlooking the coastline, and, short of words, dropped it over the edge into the trees below. We supposed some animals would eat it, or that it would decompose into the earth.

On our walk home, we discussed what we want done with our organs after death. We are both organ donors. But, if our organs were no longer viable for transplant, would

we be willing to donate our expired flesh for artistic research? Would we give our own hearts, in place of the pig's heart we had just used in our film?

I felt a morbid comfort imagining two people holding my heart tenderly in their hands, caressing and examining it intimately as we did the pig's heart in our film. We came to know the textures, seams, folds, and openings of this creature's heart so closely that when it was time to let it go, I felt loss.

Would I have felt differently if it weren't a heart? What if it was the pig's liver or intestines? Or her tongue, ear, or hoof? All of these items were readily available at the tripperie where we purchased her heart for €4.60.

Or, what if we were holding a human heart? Biologically, pig hearts are relatively similar to human hearts; porcine valves have long been used in human patients, and research regarding transplanting entire porcine hearts into humans is being actively pursued. So does it make a difference (to me, to us) if it is a pig's heart versus a human's heart in our hands?

On the transplanted heart

If we take a heart out of one body, and place it in another body, does it remain the same heart? What if we remove it again, and place it back in the original body? Now, do we have one, two, or three different hearts? Further, do we have one, two, or three different people?

In the lore surrounding heart transplants, the notion persists that it is somehow 'more' than the physical organ itself that is transplanted, perhaps aspects of the donor's personality or 'spirit' as well. In this vein, dancer Claire Sylvia wrote a memoir after her lung and heart transplant, detailing shifts in her sense of self that she attributes to the donor:

Before long, I began to feel that I had received more than just new body parts. I began to wonder if my transplanted lungs and heart had somehow arrived with some of their own inclinations and memories. I had dreams and experienced

changes that seemed to suggest that some aspects of my donor's spirit and personality now existed within me. (Sylvia and Novak 1997: 6)

Qualitative studies involving transplant recipients reveal a range of attitudes towards the incorporation of this new 'part' as part of their own body and self, in particular with regard to personality changes. In one such study researchers interviewed 47 heart transplant recipients, and summarized responses as follows: 79% of recipients denied any change in personality (which the authors attribute to denial); 15% acknowledged personality changes but attributed these to the trauma of illness and surgery rather than to the heart itself; and the final 6% (3 patients) believed that the new heart imbued them with aspects of the personality of the donor (Bunzel et al. 1992). In the first group, the 'deniers', several found the suggestion that they may experience personality changes due to the transplanted heart itself absurd; furthermore, three men who received hearts from female donors joked that entertaining this notion could have implications with regard to interpretations of their gender and sexual orientation, stating sarcastically in turn:

"Well, if that's the case, I'd have go out chasing men from now on, wouldn't I?"

"You aren't saying I'm gay now, are you?"

"I have the heart of a woman now, but still enjoy watching other women. I haven't turned lesbian, have I?"

(Bunzel et al. 1992: 253)

In contrast, one of the recipients in the latter group believed that he had literally incorporated the identity of the heart donor into his 'self', such that he was now two people in one, "living two lives"; "When asked how he was, he used to say 'WE are o.k.'" (Bunzel et al. 1992: 254). The medley of reactions expressed by heart transplant recipients with regard to their new 'part' hint at their beliefs about the thing-we-call-the-

heart in relation to the ‘self’ and the ‘soul’—beliefs which, as I will explore later in this chapter, are necessarily entangled with understandings of the human body within and between disciplinary cultures from antiquity to present day.

Discussing the ethical dimensions of heart transplantation, a team of interdisciplinary researchers involved in a study entitled “The Process of Incorporating a Transplanted Heart” (PITH), call into question what they term “the gift-of-life discourse, a chirping chorus about donor heroism and medical miracles”, raising concern that articulations of resistance and distress from transplant recipients “are often psychiatrized or dismissed, not reported in the literature or, literally, [in the case of minors] over-ruled” (Poole et al. 2009: 33). The PITH team asserts the need to prepare patients for the emotional and psychological impact of heart transplantation during pre-operative care in order to ensure “informed consent” (Poole et al. 2009: 36). The authors draw on Merleau-Ponty’s phenomenological notion of ‘intercorporeality’ to argue that:

Perhaps it may be more ethical to encourage prospective recipients to understand that the graft will never truly be their own, but part of a shared, intercorporeal relationship with the donor. Although transplant professionals may assert that the donor’s heart is a neutral “spare part” waiting to be claimed by a recipient, the reality is that each graft comes with DNA that will never lose its separate identity. As this “alien” corporeal matter is always essential to, but never the same as the recipient’s body, we suggest that perhaps this otherness should be accepted, integrated into a model of embodiment in transplantation that acknowledges, rather than denies intercorporeality. (Poole et al. 2009: 38–39)

The authors acknowledge that such a proposal is controversial, in that it undermines the logic by which donors are encouraged to sacrifice their ‘spare parts’ after death, and by which recipients are reassured they will remain or return to being their ‘same old selves’ following the transplant (Poole et al. 2009: 39–40).

In writing about his own experience as a heart transplant recipient, philosopher Jean Luc Nancy describes the ‘strangeness’ that emerged for him in the course of heart failure and transplant, with regard to sensing both his failing heart and his new heart as intruders—intruding on his sense of ‘singularity’:

A strangeness reveals itself “at the heart” of what is most familiar [...]: a strangeness at the heart of what never used to signal itself as “heart.” Until now it was foreign by virtue of its being insensible, not even present. But now it falters, and this very strangeness refers me back to myself: “I” am, because I am ill. (Nancy 2000: 4)

For Nancy, the process of extracting his ‘worn’ heart from his body and replacing it with a new one troubled what he refers to as the “‘proper’ immersion in me of ‘myself’ that had never identified itself as this body, even less as this heart, and that was suddenly concerned with and watching itself” (2000: 3). He asks: “How does one become for oneself a representation?—a montage, an assembly of functions?” (Nancy 2000: 3).

When we take one heart out of one body and place it in another body, the resulting heart and body cannot be said to be the same self-identical things, nor can they be said to be altogether other-than-themselves. The critical difference between one heart and another, in one body versus another, becomes evident following transplant at which point the recipient’s immune system will assert aggressive and relentless resistance to the ‘intruder’. From Nancy’s perspective, transplantation is not a matter of “simply ‘becoming naturalized’—[this heart’s] coming will not cease; nor will it cease being in some respect an intrusion [...]. As soon as intrusion occurs, it multiplies, making itself known through its continually renewed internal differences” (Nancy 2000: 1-2, 9). Thus it is not the presence of the foreign heart *itself*, but rather the continual renewal and multiplication of the effects of its intrusion that become *critical*.

We considered eating it. It is meat, after all. Many cultures consume pig heart, and recipes abound online. I am vegetarian, so this did not appeal to me. At the same time, I was desperate not to let this pig's heart go to waste.

If this had been a human heart, would I have considered eating it? Of course not. I am not a cannibal... isn't that what eating a human heart would say about me? In the secular Western culture in which I have come up, this is likely so. I don't know if I am capable of seeing beyond my socially constructed attitude towards the human heart, and the human body, as being made of something essentially different from animal flesh—and therefore, not as food.

I am not religious, but as a child I attended Catholic mass on special holidays with my extended family. During communion, I remember really wanting a piece of the cookie my cousins were eating. Had my parents explained that the wafer is the flesh of Christ, perhaps I would have reconsidered (but surely, with confusion and curiosity).

I find it fascinating to read about sacrificial rites in different cultures. There is evidence that the Aztecs “sacrificed human beings, tearing out their hearts on pyramids so that the sun, on which all life depended, could be nourished with the heart's blood” (Young 2002: 214). While this may sound unthinkable to some, so too could the sacrifice of Jesus Christ. According to Young: “In many places at many times, sacrificees believed in the system and were happy to go. It's worth remembering that life in this world was not always the be-all and end-all that it is now in the West” (2002: 149).

While sacrificial rituals in Ancient cultures—of animals and humans alike—are far beyond my comfort zone, I suspend judgment, because my views stem from an extremely different context. Moreover, do I think I held some moral high ground, standing on a cliff at sunset, and dropping a pig's heart (un/ceremoniously) into the woods below?

On the boundary between life and death

Attitudes towards the human heart, dissected and transplanted, are entangled with beliefs about the human brain, body, and soul—in life and death. So how is the boundary between life and death conceived in relation to the heart and other such parts? What constitutes ‘death’?

Since ancient times, death was believed to occur when heart and lung function stopped. Now that technology can maintain these functions artificially, death by

neurologic criteria—“brain death,” or the cessation of both cerebral and brain stem function—has become an accepted declaration of death. (Slade and Lovasik 2002: 68)

In contemporary Western medicine, the brain outranks the heart when it comes to declarations of ‘death’ for the purposes of organ procurement—but not without protest. According to the influential yet controversial “Uniform Declaration of Death Act” introduced in 1981 in the United States, and still widely adopted in North America: “An individual who has sustained either (1) irreversible cessation of circulatory and respiratory functions, or (2) irreversible cessation of all functions of the entire brain, including the brain stem, is dead” (Abram et al. 1981: 2). Nonetheless, there remains ambiguity regarding the point at which death can be declared, for example in situations in which minimal neurological activity persists yet physicians are confident consciousness will not return; as such, the diagnosis of ‘brain death’ for the purposes of organ donation is, at least in part, a subjective act tied to social, cultural, and religious values and beliefs (Segal 2014: 876).

Segal emphasizes the ethical dimensions of “diagnosing death” in medicine, in particular “brain death”, given the desire of physicians to procure organs for transplant as early as permissible to save other patients (2014: 875). Segal cautions that even “many family members who accept the death of their loved one, will still find it very difficult to separate themselves from the patient’s body”:

Some will quote religious reasons, such as keeping the body intact for the afterlife. Some will talk about sacrilege in the handling of a dead body, and some will quote the principle of “not enjoying (benefiting) from the dead.” These are arguments that have some roots in religion, although almost all religions have higher principles, which can be invoked when dealing with these issues, such as those regarding saving a life, doing good for others, etc. (Segal 2014: 876)

In promoting acceptance of the notion of brain death as death *itself*, advocates foreground the value of organ donation as a means for the deceased and their bereaved kin to ‘do good’ in the face of senseless and tragic accidents—accidents which “represent a [disturbing] loss of control” (Lock 2002: 10). Arguably, “through the ‘gift of life’—the ultimate act of altruism—control is to some extent reasserted and the disruption created by the accident is partly corrected, making nameless strangers into heroes” (Lock 2002: 10). The “gift of life” discourse is so prominent in North America, and to some extent in Europe, that it can be difficult to see beyond it; and yet, dis-ease about cutting into “living cadavers”—dead in ‘brain’ but not ‘body’—endures in many cultures, including cultures of science, world-round (Lock 2002: 3).

In *Twice Dead: Organ Transplants and the Reinvention of Death*, Margaret M. Lock discusses differing attitudes in Japan versus North America towards the notion of brain death, and the harvesting of organs from so-called “living cadavers” who are kept alive via artificial ventilation (2002: 3). Lock reports that in Japan, ethical debate surrounding “the brain-death problem” has been more present in the public-eye than in North America, garnering significant resistance that cannot be reduced to matters of religion and tradition, nor to “lack of education, technology, skills, or economic resources”, as Japan is a leader in medical innovation (Lock 2002: 3-5). Resisting the reification of Japanese culture as the West’s ‘other’, she argues that:

People anywhere, when actually confronted with a brain-dead body, may find it hard to think of the person as dead, because the body exhibits many signs of life. Only if the idea of the “person” is clearly confined to mind and brain can the destruction of the brain be equated with the death of the individual. On the other hand, if the concept of the “person” is diffused throughout the body, or even extends outside the body, then destruction of the brain is not easily reckoned as signifying death. (Lock 2002: 8)

While “brain death” has been medically recognized in most countries for some decades, it was not legally defined as death in Japan until 1997, and even now much skepticism persists regarding the “institutionalization” and “routinization” of definitions of death in Japan (Lock 2002: 7). This resistance may relate in part to broader conceptions of ‘death’ in Japan, i.e. as a process rather than a moment, and as a familial, rather than individual event (Lock 2002: 3). Lock acknowledges that even in North America and parts of Europe where the notion of brain death has been widely accepted since the 1980s, at least in medicine and law:

professional consensus has been lacking as to whether death is a moment or a process and how best to determinate when it occurs. No consensus exists even as to whether a definition of death should be applicable to all living forms or whether there can be a death unique to humans. (Lock 2002: 7)

Thus, around the globe, the ontological status of death is not so clear cut; the material-discursive boundaries between life and death remain open to disruption and re-articulation over time—and indeed, this boundary has been re-articulated in the past, shifting emphasis from the cessation of cardiorespiratory activity, to that of neurological function.

While the re/configuration of the boundary between life and death on the basis of the brain rather than the heart has been inspired in part by desire to procure viable organs for transplant, the cultural viability of the notion of ‘brain death’ hinges on the idea that the ‘self’ is housed within the thing-we-call-the-brain *itself*. By pinpointing consciousness and identity in the brain itself, rather than the heart or body, dissection and transplantation—for the sake of life-saving medical interventions and research—become ethically permissible.

Beliefs about the human body, brain, heart, and soul are significant in determinations of the boundary between life and death—a boundary which has been subjected to continual negotiation and reconstitution in different cultures since antiquity.

That night, we couldn't bring ourselves to have sex. Perhaps it was the blood on our hands, washed away repeatedly, but seemingly still present. Maybe it was the smell of pork, haunting our apartment. Mostly, I think it was the memory of touching the heart, sensually, together.

When we first unwrapped the heart, I had to force myself to touch it. I lifted it tentatively, sliding my fingers over its contours. I tried to avoid the small cut on my hand for fear that the fluids seeping from its openings would somehow infect me. I was afraid to drop it, or break it, despite knowing how tough the tissues of the heart are.

When we turned the camera on, I began choreographing my touch; my focus shifted to aesthetic concerns such as the framing and lighting of the heart on screen, as well as varying the texture, timing, and placement of my gestures. Diving into the familiarity of my craft, I almost forgot that it was a heart I was holding.

As we started touching the heart together, I was not prepared for the sensuality that emerged. Our fingers met gently, accidentally at first, followed by an intentional interlacing of our hands around the heart. Together, we caressed and massaged the heart, letting our fingers slip into the wide opening of the aorta, and then slide back over the smooth outer surfaces of the atria and ventricles.

The irony that we, as lovers, were holding a real heart between us—the ultimate symbol of romantic love—did not escape us. While the reality of our situation—from the odour to the blood to the fact that the heart came from a 'beast'—was far removed from any traditional notion of romance, it certainly felt very intimate. Our sensuousness and trust as partners became a part of this vulnerable (and unexpected) artistic space, which in turn infiltrated the dynamics of our personal relationship. We could not simply let this heart go and return to holding hands as if nothing had happened.

Beliefs about the human heart, brain, body, and soul in antiquity

In what follows I focus on conceptions of the human heart, brain, body, and soul in Ancient Egypt and Greece, with emphasis on attitudes towards human anatomical dissection which have resonances to present day in medicine, philosophy, and art. Notably, there are already many books which trace evolving conceptions of the heart from ancient civilizations in Greece, Egypt, China, Islam, India, and Mesoamerica, through to the Renaissance and modern times; these anthologies describe the heart as anatomical, sacrificial, religious, romantic, emotional, spiritual, metaphorical, magical, moral, and musical (e.g. Young 2002, Peto 2007, Hoystad 2007, Alberti 2010). While I draw on these and other historical texts in this section, my goal is not to provide a comprehensive review, nor to recount or rewrite historical narratives—which, even the authors of these texts acknowledge have been subjected to interpretation via cultural and linguistic translations over the course of centuries. My interest here is in un/becomings of the thing-we-call-the-heart, and likewise the -body, -brain, -soul, and -self, as sites of continual circulation and cross-contamination between bodies-of-knowledge—ancient and emergent.

On the heart and soul in Ancient Egypt

The development of medical knowledge in ancient Egypt spanned millennia, from around 4500 B.C.E. to 300 B.C.E., with undeniable resonance in Greek and Roman medicine and beyond. Much of what we know of ancient Egyptian medicine is interpreted from the surviving medical papyri, as well as archaeological specimens, which indicate a range of medical specializations in areas as diverse as herbal medicine, gynaecology and obstetrics, mummification and surgery (Adu-Gyamfi 2015: 10). Each

physician was expected to specialize in a single area, and it was physicians as well as priest-magicians who performed treatments, for as chemist/historian of science B.V.

Subbarayappa explains:

Egyptian medicine was essentially a belief system. It was believed that there were thirty-six gods of the atmosphere and thirty-six 'demons', and the human body was conceptually divided into as many parts. If a part of the body was affected, the concerned 'demon' had to be invoked for its cure. (2001: 135)

Thus, a given treatment may require herbal remedies or surgical intervention in combination with the appeasement of demons through magical rites, administered on “an auspicious day determined by the priests who were also the calendar-makers” (Subbarayappa 2001: 135).

In spiritual and medical practice alike, the heart held special significance for the ancient Egyptians as the centre of all consciousness, knowledge, and emotions (Saba et al. 2006, Willerson and Teaff 1996, Young 2002). As recorded in the medical papyri, the ancient Egyptians distinguished between the heart as an organ (haty) and the heart/soul as a spiritual entity (ib)—but again, this distinction was not an absolute binary and conditions of the heart were diagnosed and treated as dually physical and spiritual (Young 2002: 4, 7). Although the ancient Egyptians developed sophisticated medical and surgical practices, and performed disembowelling rites in the course of mummification, they are not known to have removed the heart from the body to study it anatomically (Saba et al. 2006, Young 2002). This may have been owing to their belief that the heart plays an essential role in passage to the afterlife, as described in *The Book of the Dead* (Saba et al. 2006, Young 2002).

On cardiocentrism versus encephalocentrism in Ancient Greece

For the ancient Greeks—from Hippocrates (460-370 B.C.E.) to Plato (427-347 B.C.E.) to Aristotle (384-322 B.C.E.)—there was controversy regarding whether the soul lived in the heart or brain (Crivellato and Ribatti 2007: 328). Debate between ‘cardiocentrism’ (the belief that the heart is the seat of the soul and source of consciousness, sensation, and knowledge), and ‘encephalocentrism’ (that the brain is the source), persisted from the 5th century B.C.E. into the Renaissance (Crivellato and Ribatti 2007: 329). For Hippocrates, and in several treatises of the *Hippocratic Corpus*, the brain is identified as the seat of the soul and the source of rational and conscious thought, as well as of neurological disorders (Crivellato and Ribatti 2007: 330). For Plato, the human soul was divided hierarchically between head, heart, and liver, with only ‘logos’, the part of the soul in the head, acquiring divine and immortal status. In *Timaeus*, Plato clarifies that the head “is the most divine part and dominates over the rest” and “the gods gave to [...the brain...] the whole body as servant” (Plato, cited in Crivellato and Ribatti 2007: 330). Aristotle, on the other hand, believed like the ancient Egyptians and Mesopotamians that the heart was the seat of the soul, and attributed different faculties to the multiple souls of animals and humans. These souls, all of which resided in the heart, included “the vegetative or nourishing soul” of plants and animals, the “sensitive and motor souls” of animals, and finally, the “intellectual soul (*nous*)” of humans (Crivellato and Ribatti 2007: 331).

Aristotle’s privileging of the heart over the head cannot be interpreted as ignorance of anatomy; indeed his extensive and systematic dissection of animals contributed significantly to anatomical knowledge of the brain and heart (Crivellato and Ribatti 2007: 331–332). These observations however, did not shake his belief in the cognitive

and sensory capacity of the heart, beliefs which were held by many ancients before him, and adopted by notable physicians beyond his time such as Diocles and Praxagoras in the 4th century B.C.E, and the Stoics in the 3rd century B.C.E. (Crivellato and Ribatti 2007: 332). Although Aristotle is not known to have performed human dissection, his extensive dissection and vivisection of animals demonstrated the value of repeated, systematic experimentation on bodies (Von Staden 1992: 232-233). His bold ‘materialist’ philosophy, adopted by both the Stoics and Epicureans in Alexandria, may also have influenced attitudes towards the human body and corpse. In *Meteorologica*, Aristotle asserts:

It is clear that a corpse is a human being in name only [...]. Even though a dead person also has the same external form and shape, it nevertheless is not a human being. [...] For it will not be able to perform its own function, just as neither flutes [sculpted] in stone nor physicians in drawings can perform their own functions. Likewise none of the parts of a dead person is any longer of such a nature [as are the functioning parts, i.e., of a living person]. (Aristotle, cited in Von Staden 1992: 233)

Taking Aristotle’s sentiment a step further, in the radical materialism of Stoicism and Epicureanism, it was reportedly believed that: “all entities, animate and inanimate, are nothing but matter”; even the soul is “nothing but matter of a certain kind or in a certain state” (Von Staden 1992: 233). As such, “neither death nor the corpse is to be feared: death is simply either a change in the state of matter or a rearrangement of matter” (Von Staden 1992: 233). From the perspective of radical materialism, there is no reason, physical or spiritual, to fear human dissection, because it is merely a rearrangement of spare parts which no longer serve any function in life.

Debate between cardiocentrism and encephalocentrism, as well as the relation of the human soul to the heart, brain, and body, endures to present day in medical,

philosophical, spiritual, scientific, and artistic contexts. Although the radical brand of materialism expressed above may be rare in contemporary discourse about the body and corpse, the ethical and aesthetic dimensions of encounters with and representations of the material body-mind-soul are implicit within any and all (inter)disciplinary research concerning the human body—especially research which probes beneath the skin by way of dissection, or even vivisection.

On the rise and fall of human anatomical dissection in Alexandria

The earliest recorded dissections of human cadavers—and occasional vivisections of condemned criminals—were performed in Ptolemaic Alexandria in the 3rd century B.C.E. by the Greek physicians Herophilus, and his contemporary Erasistratus (Crivellato and Ribatti 2007: 332, Von Staden 1992: 223).⁷ Breaking with long-standing traditions in Ancient Egypt and Greece alike, their pursuit of human anatomical dissection afforded significant contributions to neuroanatomy, including the identification of the central nervous system, and the distinction between nerves (which they associated with the brain), and blood vessels (which they associated with the heart) (Crivellato and Ribatti 2007: 333). Despite these successes, human dissection once again ceased—or at least receded from the public eye—following the brief tenure of these physicians. What narrative might account for the rise and fall of human anatomical dissection in Alexandria?

⁷ There may have been people practicing human dissection prior to this period, but more discreetly and without documentation, because it was considered taboo.

In *The Book of the Heart*, Louisa Young suggests that the public practice of human anatomical dissection became possible owing to the rise of Alexandria as a cosmopolitan city with a medical school, where knowledge from the Egyptian tradition of mummification came together with Greek philosophy “which held that only the soul, not the body, could expect immortality” (2002: 22–23). Young adds that the slaves and condemned criminals used for dissection and vivisection “were not considered entirely human—except in body” (2002: 23). In a similar vein, historian Heinrich Von Staden points to the political climate of Alexandria as a significant factor in the acceptance, or at least tolerance of human dissection. He notes that unlike Athens, Alexandria was not a democracy. As such, Herophilus and Erasistratus were not held to account by fellow scientists or the local community but rather answered to royal patrons (Von Staden 1992: 131). In addition to financial patronage, it is reportedly the Kings who provided cadavers for dissection, as well as condemned criminals for live vivisection (Von Staden 1992: 131). For the elite of Alexandria, acquiescing to human dissection may have reflected their ambition to establish Alexandria as the literary and scientific centre of the world (Von Staden 1992: 231–232). Indeed, evolving beliefs regarding the materiality and mortality of human flesh, versus the immateriality and immortality of the human soul, may well have played a role in reducing (although not eliminating) public resistance to human dissection during this period.

But what were some of the sources of resistance to human dissection in the centuries preceding and following this brief period in Alexandria? Von Staden turns to the Greek sacred laws of the preceding centuries which undoubtedly remained during this period and beyond, to probe valorizations of the corpse, the skin, and cutting (1992: 223–241). As evidenced in the sacred laws, the Greeks believed that the corpse was a source of

pollution that could contaminate people who came into contact with it, as well as the spaces it inhabited; as such, the laws outlined rituals to make the corpse symbolically pure, and to cleanse the bodies and homes of the kin who prepared the corpse for burial (Von Staden 1992: 226–227). Following burial, these purification rituals could last weeks to months and included isolation from other community members and sites, to prevent contamination (Von Staden 1992: 227). The idea of cutting open the skin of a corpse was particularly taboo because the skin was considered to be “the exterior sign-system of the interior, the external surface on which both internal physical disorder and internal moral pollution become physically manifest” (Von Staden 1992: 228).

Furthermore, the skin of the individual was valorized

as a visible symbol of the invisible "skin" that envelops and protects the community [...] of that which ensures that the collectivity will function as a social entity in which all parts have their stable, proper place, as do parts inside the skin of a healthy individual body. (Von Staden 1992: 228)

Apart from minor incisions for therapies such as blood-letting, the ancient Greeks reserved the violence of deep skin transgressions for the sacrifice of animals and for combat, both of which “belong to a context of overcoming a crisis—of coping with a threat, of resolving a critical disorder, imbalance, impurity, or impasse” (Von Staden 1992: 230). From fear of the corpse as a source of contamination, to the symbolic status of the skin, to the risk and violence attributed to cutting, Von Staden articulates several reasons for which human dissection was taboo in ancient Greece.

Another major source of resistance to human anatomical dissection, and to materialist philosophy more generally during late antiquity, was the Empiricists. Led by a student of Herophilus, the Empiricists lay the grounds for modern day clinical examination, without recourse to cutting (Edelstein 1935, Von Staden 1992, Chihara and Chihara

1993). In the 3rd Century B.C.E., the Empiricists raised the argument that: “the invasive investigation of ‘hidden causes’ and the construction of causal theories [was] unnecessary, impossible in principle, and clinically irrelevant”; in place, they assessed symptoms through direct ‘empirical’ observation of experience, and treatment with external remedies (Von Staden 1992: 235). In addition to objecting to human dissection and vivisection on moral grounds, the Empiricists argued that “the very act of laying open the body alters the internal parts, and that even uninjured parts often vary in appearance due to non-pathological factors such as fear or hunger or fatigue” making it difficult to draw conclusions about the behaviour of such parts in a living body (Von Staden 1992: 236). The Empiricists pit themselves against the Greek physicians before them, who they labelled as the “Rationalists” or “Dogmatists” for their use of theories to explain bodily affectations (Edelstein 1935: 236, Von Staden 1992: 236). Although the Empiricists refused (at least outwardly) to perform human anatomical dissection, they undoubtedly benefited from and built upon the research and scholarly documents produced by their predecessors in Alexandria (Von Staden 1992: 236).

On ‘psychic pneuma’ of Galen

During the Roman period in Alexandria in the 2nd century C.E., the physician Galen of Pergamon (129-216 C.E.) made significant advances in neuro- and cardiovascular anatomy. Counter to the cardiocentrists of the preceding century such as Aristotle and the Stoics, Galen sought to prove empirically that it was the brain, not the heart, that was the seat of consciousness, thought, sensation, and movement (Crivellato and Ribatti 2007: 334). He believed, like Herophilus and Erasistratus before him, that a “rational investigative methodology” involving dissection and vivisection was essential to medical knowledge (Crivellato and Ribatti 2007: 334). Unlike his predecessors

however, Galen primarily had access to animals such as ox for dissection, from which he extrapolated to humans (Crivellato and Ribatti 2007: 334). One way in which Galen departed from past physicians, was that he “did not attempt to localize the rational soul in a specific part of the brain”, and instead proposed that it was the “psychic pneuma that functioned as the first instrument of the rational soul”, accounting “for mental activities like thoughts and memory as well as sensation and voluntary motion” (Crivellato and Ribatti 2007: 334). More specifically, Galen posited: “air drawn in through the trachea was changed in the lung tissues to become vital pneuma” which then “mixed with blood [and] travelled in the arteries to the base of the brain where it was transformed into psychic pneuma” (Quin 1994: 393). For Galen the human soul “was intimately connected with brain tissue which [...] communicated with the nerves by means of the psychic pneuma”, and thus, despite his encephalocentrism, he disagreed with Plato’s contention “that man had an immortal soul independent of the body” (Quin 1994: 393).

On Christian and Cartesian beliefs about the heart, brain, body and soul

With the rise of Christianity in the 4th century C.E. and throughout the Middle Ages, attempts were made to reconcile the work of Aristotle and Galen with religious doctrine, especially regarding the materiality versus immateriality, and mortality versus immortality of the human soul (Quin 1994: 393). It was not until the 13th century C.E. onwards, with the return of public human dissection, that physicians such as Andreas Vesalius (1514-1564) and William Harvey (1578-1657) presented major challenges to the work of Aristotle and Galen. In 1628 Harvey demonstrated the circulation of blood, and stated, contrary to followers of Galen, that he was not able “to find natural, vital or animal spirits [...] in his dissections and that discussion of the part they played in the

functions of the body was merely an attempt to avoid admission of ignorance” (Quin 1994: 393). This was not to be the end, however, of spirit-based explanations of the soul within and beyond the human body.

René Descartes (1596-1650) proposed mechanistic explanations of the body, in which Galen’s “animal spirits” were reimagined as the “basis of nerve and muscle function”, and as the source of bodily movements and reflexes via the “inflation of muscles and their shortening as originally described by Erasistratus” (Quin 1994: 393-394).

Descartes believed that “man had a rational soul independent of the body, but no soul of any kind was present in other animals which in his opinion functioned like automata” (Quin 1994: 394). He argued further that “interaction between soul and body took place in the pineal gland and it was there that conscious appreciation of sensations occurred and voluntary movements were initiated” (Quin 1994: 394). Thus, for Descartes it was the human soul—enacted in the pineal gland of the brain, which in turn acted upon the rest of the body via “the distribution of spirits”—that was responsible for human consciousness (Quin 1994: 394).

Significantly, Descartes’ approach to examining the human body was heavily swayed by his desire to reconcile scientific reason with Catholic theology, and to prove with absolute certainty the existence of God, as well as “the real and true distinction between the soul and body” (Descartes 1641: 4). In *Meditations of First Philosophy*, Descartes argues that:

although it is quite enough for us faithful ones to accept by means of faith the fact that the human soul does not perish with the body, and that God exists, it certainly does not seem possible ever to persuade infidels of any religion, indeed, we may almost say, of any moral virtue, unless, to begin with, we prove these two facts [that the human soul does not perish with the body, and that God exists] by means of natural reason. (Descartes 1641: 4)

Thus, the entanglement of Cartesian and Christian doctrine vis-à-vis the body and soul, or more accurately the body as vessel for the soul in life and afterlife, must be taken into account in any analysis of Descartes' scientific and philosophical contributions.

Conclusion

Wide-ranging beliefs about the significance of the human heart, brain, body, and soul not only permeate but produce boundaries between bodies-of-knowledge in medicine, philosophy, and art—boundaries which remain vulnerable to destabilization through contact with foreign disciplinary perspectives and value systems. My discussion of human heart transplants, and likewise of the role of the human heart and brain in determinations of the boundary between life and death, are presented here as a means to probe for critical differences in conceptions and representations of the thing-we-call-the-heart, in relation to the things-we-call-the-body, -brain, -mind, and -soul across disciplines and cultures over millennia. In appropriating narratives regarding beliefs about the heart in ancient Egypt and Greece, my appropriation becomes 'critical' in that it is not aimed at representing or reproducing knowledges from another context; rather, as I re/narrate these narratives in the context of my thesis, my goal is to bring them into diffractive relation with my interpretation of contemporary narratives. In this way, I aim to craft conditions in which differentiated narratives spill through and around one another, creating interference and entanglement in their re/imaginings of ghostly peoples, practices, and things—past, present, and future.

Throughout this chapter, as in the previous and subsequent, my dilation between broad historical reports on cultural beliefs and practices (for example concerning the 'body' and 'heart'), to first-person reflections (for example from the heart transplant

recipients), is *not* a means to reconcile their scope, nor to elevate one voice above another. Rather, in the collision of the incommensurable accounts—cultural and personal, scientific and spiritual, objective and subjective—my approach to setting up conditions for diffraction relates to what Foucault describes as a genealogical method.

In Foucault's words:

[genealogy] must record the singularity of events outside of any monotonous finality; it must seek them in the most unpromising places, in what we tend to feel is without history—in sentiments, love, conscience, instincts; it must be sensitive to their recurrence, not in order to trace the gradual curve of their evolution, but to isolate the different scenes where they engaged in different roles. (Foucault 1984: 76)

Barad too, speaks of the value of genealogy in diffractive methodologies as “a method attuned to the entanglement of the apparatuses of production, one that enables genealogical analyses of how boundaries are produced rather than presuming sets of well-worn binaries in advance” (2007: 30). Moving into the next chapter, my deconstructive analyses of the thing-we-call-the-heart and the thing-we-call-the-body support a genealogical analysis of the ways in which the introduction of new tools and techniques for sensing physiological processes transformed the gaze of 19th century physicians—and in turn the gaze of the so-called ‘brainwave music’ composers in the 1960s.

Chapter 5: Practices of perception, from medicine to music

Opening Questions: Since the early-mid 19th century, how has the development of biomedical sensors shifted the boundaries of intelligibility of the human body, without recourse to cutting? With the appropriation of biosensors from medicine into the arts, for example in music composition, how can the motives, methods, and modes of articulation of researchers be differentiated, and therefore made intelligible, within and between bodies-of-knowledge?

Introduction

In one room there is a neurologist listening to a sonic representation (sonification) of brainwaves from an electroencephalogram (EEG) to assist in the diagnosis of a patient.⁸ In the next room there is a new music composer listening to the same sonification of the same EEG data, but for integration in a concert with live electronics and chamber orchestra. Given their divergent motives and training, what might each practitioner hear—or not hear—in this sonified EEG signal? Considering their respective fluencies about the brain and about sound, as well as in the use of medical and musical technologies (which may of course overlap), how are their disciplinary frames of reference differently constituted to foreground particular details, at the expense of others? If we now bring the neurologist and the composer into the same room to discuss what they found significant about the EEG sonification, how might their responses differ, and to what effect? Can we account not only for differences in perception

⁸ Neurologists commonly assess visual representations of EEG data, however sonification techniques are used in some cases as well, e.g. Parvizi et al. (2018).

attributed to expertise, but also for the effects that these differences come to make in discourse about bodies within and between disciplinary cultures over time?

In this chapter I shift from questions about the boundaries of the human body, heart, brain, and self as discussed in the previous chapters, to concerns raised by the appropriation of biosensing technologies from medicine into art. Within and between medical and artistic contexts, the design of visual and sonic representations of ‘internal’ physiological processes illuminates the entanglement of ontology, epistemology, ethics, and aesthetics in cross-disciplinary research about bodies and movement. In the appropriation of biosensors from medicine to art, an interrogation of the processes of differentiation within and between the objectives and methods of each community of practice illuminates not only those conceptions of bodies, biology, technology, and interaction that are manifest, but also, those becomings that are excluded. Through this continual, constitutive exclusion the ethical boundaries of disciplines are enacted, rendering expressions significant or non-signifying within their disciplinary frame of reference. Over time, excluded people, practices, and perspectives come “to haunt those boundaries as the persistent possibility of their disruption and rearticulation” (Butler 1993: 8). The critical question I am concerned with in this chapter is: what conceptions of bodies, and of biology and biodata, are haunting the boundaries of medical and artistic practices with biosensors?

The focus on medicine, visual art, music composition, and interaction design in this chapter and the next, despite my background as a choreographer, is owing to the inherently cross-disciplinary character of creation with biosensors. I am curious about the ways in which motives and methods (my own included) become haunted at various

stages of cross-disciplinary research and creation. This haunting may progress throughout the design of biosensor hardware and software, in techniques of touching, listening, and looking, and via the sonification, visualization, and haptification of biodata to shape a context in which relationships take form—not once and for all, but for here and now. In *III*, we approach choreography and composition as the crafting of performance contexts in which this haunting may become integral to that which constitutes the choreography and composition itself, based on the frame of reference of each participant—animate and inanimate, material and immaterial, human and inhuman.

In what follows I discuss the development and use of electrical biosensors in medical practice, as well as their appropriation into artistic practice. To begin, I draw on Foucault's genealogy of medicine in *Birth of the Clinic* (1973) to examine the operation of the medical gaze and instrumental mediation between doctors and patients over the course of centuries. I then discuss the work of Étienne-Jules Marey (1830–1904), cardiovascular physiologist turned chronophotographer, as an example of enduring desire in medicine and art alike to visualize the invisible, sonify the inaudible, and touch the untouchable depths of living, breathing, moving bodies. Following on, I discuss the appropriation of biosensors from medicine into music composition and interaction design, with regard to the generative and mutual destabilization afforded by cross-contamination between bodies-of-knowledge. In the movement of sensing technologies and techniques between disciplinary cultures, what may be perceived as representations of 'natural' and 'artificial' processes become intelligible only through their entangled-differentiation within the human body—and the human body becomes intelligible only through its entangled-differentiation from other bodies *within* and *as* bodies-of-knowledge.

Biosensors and ‘practices of perception’ in modern medicine

On the medical gaze

In *Birth of the Clinic* (first published in French in 1963, and translated to English in 1973), Foucault provides a genealogical analysis of the ‘medical gaze’ from the early 17th through to the mid 20th century, emphasizing shifting distributions of the “visible and invisible” as well as “what is stated and what remains unsaid” with regard to signs and symptoms of life, disease, and death in and of the human body (1973: xi). He notes the transition “whereby the question: ‘What is the matter with you?’, with which the eighteenth-century dialogue between doctor and patient began [...], was replaced by that other question: ‘Where does it hurt?’”, reflecting spatial mappings of the body produced in pathological anatomy, as well as the desire of clinical empiricists to “silently let things surface to the observing gaze without disturbing them with discourse” (Foucault 1973: xviii–xix).

Foucault elaborates that the doctor’s gaze—“supported and justified by an institution” and “endowed with the power of decision and intervention”—is not primarily concerned with objective observation; on the contrary, the doctor’s gaze requires aesthetic insight through “colours, variations, tiny anomalies, always receptive to the deviant” in order to calculate “chances and risks” and foresee the future by way of past knowledge and experience (Foucault 1973: 89). In clinical diagnosis, the translation from gaze to language—forming the great “speaking eye” of medical truth (114)—relies on hearing and touch as much as sight:

Each sense organ receives a partial instrumental function. And the eye certainly does not have the most important function; what can sight cover other than ‘the tissue of the skin and the beginning of the membranes’? Through touch we can locate visceral tumours, scirrhus masses, swellings of the ovary, and dilations

of the heart; while with the ear we can perceive ‘the crepitation of fragments of bone, the rumbling of aneurism, the more or less clear sounds of the thorax and the abdomen when sounded’. The medical gaze is now endowed with a plurisensorial structure. A gaze that touches, hears, and, moreover, not by essence or necessity, sees. (Foucault 1973: 164)

In early Greek medicine dating back to Hippocrates of Cos (circa 460-377 BC)—prior to the invention of electrical biosensors—doctors employed this “sight/touch/hearing trinity” through a combination of phenomenological techniques (Foucault 1973: 162).

Beyond the patient’s own account of symptoms, these techniques involved visual inspection, palpation, percussion (tapping on the body to assess solid masses like organs versus air-containing structures, as well as fluids in the chest or abdomen), and auscultation (listening to sounds inside the body, like the *lubdub* produced by the closing of the heart valves) (Kaniusas 2012). While these visual, tactile, and aural biosignals remain significant to present day clinical examination, it was recognized early on that they are highly subjective: “Analysis of the biosignals was restricted to instantaneous impression by the physician, with the impression being strongly affected by the physician’s personal experience”; furthermore, medical training in this era was highly un-standardized, allowing for wide-ranging interpretations of signs and symptoms (Kaniusas 2012). From the late 17th to mid 18th century, attempts to objectively record, reproduce, compare, and share biosignals progressed from verbal description, to musical notation, to “technical tools” (Kaniusas 2012). In the case of musical notation, reportedly used by many physicians in this period, the height of the notes on the staff expressed qualitative characteristics of the biosignal, while the lateral distribution of the notes indicated rhythm (Kaniusas 2012). For example, flute teacher François Nicolas Marquet (1687-1759) used musical notation to document thirty

different behaviours of the pulse, as a way to evaluate changes in blood pressure (Kaniusas 2012).

In these early endeavors to codify representations of biodata—impregnating phenomenal perception with positivist significance—what is evident is not the emergence of oppositional ideologies, but rather, the entangled genealogy of the medical gaze:

[...] when one carries out a vertical investigation of this positivism, one sees the emergence of a whole series of figures—hidden by it, but also indispensable to its birth—that will be released later, and, paradoxically, used against it. In particular, that with which phenomenology was to oppose it [positivism] so tenaciously was already present in its underlying structures: the original powers of the perceived and its correlation with language in the original forms of experience, the organization of objectivity on the basis of sign values, the secretly linguistic structure of the datum, the constitutive character of corporal spatiality, the importance of finitude in the relation of man with truth, and in the foundation of this relation, all this was involved in the genesis of positivism. (Foucault 1973: 199)

Phenomenology and positivism, like materialism and constructivism, have come to haunt one another as exteriorities-within, always-already entangled in interpretations of the signs and symptoms of life, disease, and death.

On instrumental mediation

In the 19th century, the urgency to develop new ‘technical tools’ to reveal the imperceptible and mediate contact between doctor and patient was hastened by religious and cultural concerns of modesty and morality, as well as class-based prejudice. This “moral screen, the need for which was recognized, was to become a technical mediation” justified by normative scientific and social beliefs about the body (Foucault 1973: 163). The conception of one of the earliest tools for biosensing—the stethoscope—is attributed to French doctor René Théophile-Hyacinthe Laënnec:

In 1816, I was consulted by a young person who presented symptoms of heart disease, and in the case of whom the application of the hand and percussion yielded poor results on account of her plumpness of figure. Since the age and sex of the patient forbade me the kind of examination of which I have just spoken (the application of the ear to the precordial region), I happened to recall a well-known acoustical phenomenon: if one places one's ear at the end of a beam, one can hear very distinctly a pin dropped onto the other end. (Laënnec, cited in Foucault 1973: 164)

To avoid immediate auscultation, i.e. placing his ear directly to the chest of a female patient, Laënnec rolled up a tube of paper through which to listen to the amplified physiological signals of her heart and lungs. In so doing, he effectively produced the first prototype of the modern-day stethoscope as a tool for amplifying previously inaudible signals, and as a technology of mediation between doctor and patient.

Through instrumental mediation, the stethoscope not only extends the plurisensorial machinery of the medical gaze, but also responds to and reinforces cultural sensibilities regarding appropriate touch and proximity between doctor and patient:

Instrumental mediation outside the body authorizes a withdrawal that measures the moral distance involved; the prohibition of physical contact makes it possible to fix the virtual image of what is occurring well below the visible area. For the hidden, the distance of shame is a projection screen. What one cannot see is shown in the distance from what one must not see. (Foucault 1973: 164, orig. italics)

The above passages from Foucault and Laënnec point to the inherently value-laden character of the development of any new technology, as well as techniques for use in a given disciplinary context—values which may transit disciplines with the appropriation of technologies beyond their intended use. As technologies and techniques of perception transform over time—within and between disciplines—the perceived boundaries of bodies, and the ways in which ‘biological’ processes become intelligible, may too be reconfigured.

Building from Foucault's account of instrumental mediation, Jonathan Sterne, whose research traverses sound studies, media theory, and science and technology studies, discusses mediate auscultation (i.e. listening to the body with a stethoscope) as a "technical approach to hearing" and "a highly structured activity that requires practice to perfect" (2001: 117). In order "for the sounds produced by mediate auscultation to signify properly—that is to say, indexically—it demands a facility with technique, a certain level of virtuosity" (Sterne 2001: 134). As a "practice of perception" mediate auscultation emphasizes the autonomy of hearing, as well as "a particular kind of framing of sound" in which "only sounds inside the frame were to be analyzed or considered. The sounds of the apparatus itself, and the other sounds accompanying auscultation were to be ignored" (Sterne 2001: 122).

As a part of the instrumental reasoning underlying the entire procedure, the character of the instrument itself must be erased from consciousness during mediate auscultation. In classic technological deterministic fashion, the tool stands in for a whole process from which it erases itself. (Sterne 2001: 123)

Importantly, the distinction between immediate and mediate auscultation in medical history (i.e. the doctor listening with an ear to the patient's chest, versus with a stethoscope), assumes that there is such a thing as direct, unaffected listening. To the contrary, each human ear has its own folds and form that shift throughout life, both internally and externally, thus filtering sounds differently. Additionally, sound perception is informed by one's quality of attention and interest in the task at hand. As such, the role of the stethoscope becomes entangled within the listening process in ways that cannot be causally extricated from 'immediate' (or pre-culturally constructed) sensing. This is not due to lack of skill, but rather, it is because un-mediated sensing does not exist. The erasure of the instrument from the perceptual process is important to

consider, because it obscures the relationships and meaning-making underway, allowing the ethical and aesthetic values that inform its operation to remain unexamined.

Further, in positioning the stethoscope as a perceptual mediator between the heart/body being listened to, and the human listener, there lies an implicit assumption; namely, that ‘source’ and ‘receiver’ are separate and distinguishable entities to begin with, that come into contact at the point of mediation. On the contrary, the use of the stethoscope to mediate contact between doctor and patient, is influenced by the value-laden design of the hardware and software which necessarily involves amplification, averaging, and exclusion of aspects of the biosignal that do not serve the objectives at hand.

Invocations of technology as a mediating force to reveal the intimate interiors of bodies, and augment the sensory capacities of the investigator, arguably (and perhaps inadvertently) reinforce binaries of passive/active and object/subject. Once divided, this passive object and active subject can be made to interact via unidirectional channels of influence and control.

The ways in which a doctor and patient touch—as transduced through the material composition of each stethoscope as well as their own bodies—produces ‘noise’ in the biosignal. ‘Noise’ in this sense is constituted by any artifacts in the biosignal, or in interpretations of the biosignal, that are labeled extraneous to the enunciations of the cardiovascular system itself, i.e. the instrument, the ear, or the quality of touch. Only through disciplinary training can a doctor learn to isolate the ‘biological signal itself’ from the ‘artificial noise’ produced in mediate auscultation. As Sterne points out:

While empiricism is usually cited as the operative epistemology of early modern medicine, an epistemology of mediation is equally central to the apprehension of that sensory data which would yield up its truth: you had to have the right tools

and training to hear it for yourself; the truth might not immediately yield itself up for the untrained listener. (Sterne 2001: 118)

As an antidote to the uncertainty caused by rare or even inexplicable signs and symptoms—not unlike artifacts in biosignals—Foucault discusses the role of probabilistic thought in early diagnostic medicine:

Relying on the concept of sympathy, eighteenth-century doctors had used and abused the notion of ‘complication’, which always enabled them to find a pathological essence by simply extracting from the manifest symptoms whatever elements contradicted the essential truth, and these elements were then labelled as interferences. (Foucault 1973: 101)

Through this filtering, by way of perceptual and technological intervention, “medical certainty is based not on the completely observed individuality but on the *completely scanned multiplicity of individual facts*”, such that the “only normative observer is the totality of observers: the errors produced by their individual points of view are distributed in a totality that possesses its own powers of indication” (Foucault 1973: 101-102, orig. italics). In this quest to perceive the imperceptible through instrumental mediation, unfamiliar or ‘noisy’ signals may be labelled as interference—non-signifying, and therefore insignificant—within the continual enactment of disciplinary boundaries.

On the perceptible imperceptible

An early example of the intersection of medical and artistic practices in the 19th century is evidenced in the work of French cardiovascular physiologist turned chronophotographer, Étienne-Jules Marey (1830–1904). Marey contributed to the development of several medical instruments used to amplify and visualize the temporal motion of arterial blood, pulse, blood pressure, valve motion, and ventricular contractions (Silverman 2001: 339–340).

During a lifelong search for the parameters of movement, its amplitudes, periods, phases, and fluctuations, Marey rejected observation and sensory information, calling it imprecise and elusive. Bringing the invisible to the surface would be accomplished only through the construction of machine inscriptions disjointed from the deceit of the human senses—the “discovery of how to make recordings without recourse to the human hand or eye,” which followed a long post-Enlightenment trajectory of devices rendering visible the invisible forces of the human body. (Dagonet 1992: 30, cited in Salter 2010: 122)

Marey’s expertise in physiology allowed him to collaborate to invent, augment, and employ medical sensing technologies in a manner inaccessible to most non-medical professionals of his time due to prohibitive scale and cost. The graphic representations of timed physiological data generated by medical instruments in the mid-late 19th century such as the ‘kymograph’ and ‘sphygmograph’ required specialized training to decipher (Silverman 2001: 339). As such, these tools signified diagnostically only through the intervention of human interpretation and description.

Marey’s devotion to empirically reveal the imperceptible through instrumental mediation reflected Cartesian belief in the deceitful nature of sensory perception as an obstacle in the pursuit of scientific knowledge.⁹ In Marey’s own words:

If indeed, graphic expression makes it possible for us to obtain scientific evidence, let us leave eloquent insinuation and flowery language to fulfil other roles; let us plot and compare the curves of the phenomena we investigate and forge ahead like geometers, whose proofs are never questioned. (Marey, cited in Silverman 1996: 339)

⁹ An explanation of Cartesianism is provided in Chapter 3 of this thesis, pp. 51-53.

Marey's distrust of verbal narratives of signs and symptoms, whether produced by patient or doctor, denotes a conceptual shift from 17th to 19th century medicine. As Foucault explains:

At the beginning of the nineteenth century, doctors described what for centuries had remained below the threshold of the visible and the expressible, but this did not mean that, after over-indulging in speculation, they had begun to perceive once again, or that they listened to reason rather than to imagination; it meant that the relation between the visible and invisible—which is necessary to all concrete knowledge—changed its structure, revealing through gaze and language what had previously been below and beyond their domain. A new alliance was forged between words and things, enabling one to see and to say. (Foucault 1973: xii)

Marey was in search of images that could speak their own essence, free of instrumental or discursive interference—and yet, as he shifted from visualizing the internal movements of the cardiovascular system, towards chronicling the micro-movements of humans, animals, objects, and elements like smoke using 'chronophotography', his engagement in aesthetic experimentation—forsaking so-called 'un-mediated' representation—is hard to deny (Silverman 1996: 340).

Marey not only adopted but redesigned the tools and techniques of 'chronophotography', a Victorian era means of capturing successive frames of movement and compiling them in a single frame or as an animation. In so doing, Marey paved the way for modern photography and cinematography, producing images of processual movement that inspired the Futurists, and which are exhibited at international galleries such as the Metropolitan Museum of Art (MET), the Museum of Modern Art (MoMA), and the Musée d'Orsay to present day. Marey's chronophotographic work is an elaboration of Charles Darwin's use of "photography to freeze transitional moments for scientific evaluation" in *The Expressions of the*

Emotions in Man and Animals (1872), which also inspired Eadweard Muybridge in the United States (Lenoir 1998: 180). Like Darwin, Marey endeavoured to reveal truths about the biological evolution of the ‘natural’ body through scientific analyses and representations of biodata—but again, the status of the representations of bodies and movements produced by Marey warrant further analysis, beyond a positivist frame. In Marey’s work, the transit of perceptual tools and techniques from medicine to art imbued the images he created with a hybrid gaze, coloured by his training as a cardiovascular physiologist, as well as his expertise as an artist. As such, the purview of the ‘medical gaze’, inscribed in Marey’s tools and techniques, transited with him from what might be considered scientific to artistic research, troubling the boundary between the two.

Marey’s slippery passages between science and art, producing representations of the processual movement of bodies and biology, has garnered interest in the domain of process philosophy as well. Philosopher Erin Manning argues that Marey’s enduring study of processual motion led him beyond quantitative measurement and representation of pre-constituted forms, towards “the exploration of incipency, graphing not only curves of movement [as outcomes] but curves in movement [as processes]” (2009: 84). In this way, “movement research that may have begun as an exploration of an already-constituted reality becomes a mechanic intervention into the not-yet-seen”, and Marey’s “perception machines” become implicated in relational processes of perception which reveal the process of perception itself (Manning 2009: 99). Manning’s re/framing of Marey’s work may not have sat well with his desire to “plot and compare the curves of the phenomena [...] and forge ahead like geometricians, whose proofs are never questioned” (Marey, cited in Silverman 1996:

339)—but this does not really matter to this discussion. The point here is not to excavate a version of truth about the origin and evolution of Marey's work, nor is it to judge the value systems involved. What is of interest here, is the opportunity afforded by Marey's boundary-crossing for diffraction between multiple differentiated-yet-entangled bodies-of-knowledge—scientific, artistic, philosophical—over the course of centuries. In Marey's work, the notions of the medical gaze and instrumental mediation transit disciplinary contexts via his repurposing and redesigning of tools and techniques to serve alternate motives, methods, and modes of articulation. Rather than visualizing imperceptible bodily processes solely for medical examination, Marey expanded the scope of his work to incorporate aesthetic experimentation and representations that probe the boundaries of intelligibility of bodies and movement more broadly.

In the ongoing use of technologies beyond their intended purpose—surely even more common now than in Marey's time—the medical gaze casts its eyes, ears, and hands beyond the clinic, towards wide-ranging disciplinary understandings of bodies and technology. In the appropriation of biosensors from medicine into artistic research, creation, and performance, it is not only biomedical tools that are recontextualized, but also traces of the value systems inscribed within their design and operation.

Differentiating between medical and artistic applications of biosensors, in terms of motives, methods, and modes of articulation, is a messy endeavour involving continual cross-contamination and inter-penetration between bodies-of-knowledge.

In the remainder of this chapter, I examine the appropriation of biosensors from medicine into music composition in the 1960s, with attention to the ethical and aesthetic dimensions of such de- and re-contextualizations of technologies. I could likewise

discuss the appropriation of artistic practices with biosensors into medical settings, for example in projects that invite artists into hospitals—but this is beyond the present scope. From medicine to art or art to medicine, the point (my point) remains: in sustained acts of transgression, contamination, and penetration between bodies-of-knowledge, innovation develops not in spite of, but because of critical differences that move within and between disciplinary knowledges.

Biosensors from medicine to music: Sonification and biofeedback

Early music compositions involving the real-time sonification of electrical waveforms from the brain, heart, and neuromuscular activity of performers—registered using electroencephalograms (EEGs), electrocardiograms (ECGs) and electromyograms (EMGs)—were pioneered in the 1960s by composers such as Alvin Lucier, Richard Teitelbaum and David Rosenboom. In what has been coined ‘brainwave music’, these composers adopted and adapted techniques from biomedical and psychological research such as ‘sonification’, i.e. translating physiological processes into perceptible sound, and ‘biofeedback’, i.e. relaying back to subjects interpretations of their physiological state in order to reinforce learning of behavioural patterns. In re/contextualizing biomedical tools, these composers departed, at least partially, from medical objectives such as monitoring and diagnosis, towards ‘musical’ expressions of biodata aligned with their aesthetic values and training as composers.

The following discussion of biosensors in ‘brainwave music’ is structured in three parts: firstly, I consider Lucier’s articulation of biosensors as an intervention in his authority and decision-making processes as a composer, and as a means to trouble his understanding of what constitutes ‘composition’ itself; secondly, I discuss the tension

expressed by Teitelbaum between his aesthetic values and disciplinary training; finally, I consider Rosenboom's insistence on biofeedback as a *dynamical* and *autopoietic* process in interactive performance. In the work of all three composers, the notions of the medical gaze and instrumental mediation remain relevant, with regard to the practices of perception through which biological processes become intelligible and available for representation.

On biosensors as an intervention in compositional authority

A detailed account of the development of Alvin Lucier's *Music for Solo Performer* (*MfSP*) from its premiere to its re-imaginings, is provided by Volker Straebel and Wilm Thoben (2014); the authors also draw from their first-hand involvement in a performance of the piece supervised by Lucier in 2012. Straebel and Thoben emphasize that in *MfSP*, as in all uses of biodata for sonification and biofeedback:

the direct transmission of EEG data to loudspeakers that excite percussion instruments via sympathetic vibration is an illusion, an intended theatrical effect. Between data detection and sonic result lies a whole chain of decisions, operations and technical devices that may constitute the technique of sonification. (Straebel and Thoben 2014: 17)

Interrogating the technique of sonification is one strategy to resist the erasure of instruments from interpretations of the perceptual process. Straebel and Thoben elaborate that: "The iconic image of a soloist performing motionlessly and relying only on brain waves to control percussion instruments is an artistic creation by the composer, not the technical reality of the piece" (2014: 27). On the other hand, they suggest that obfuscating the complex operations involved in transforming "alpha signals into resonating percussive sounds" can be a persuasive artistic tactic—a means to produce mystique—for "it is this image of the direct translation of brain activity into sound that

gives reason for the work's fame and its perception in sonification research" (Straebel and Thoben 2014: 26).

While *MfSP* involves the appropriation of EEGs and sonification techniques, neither Lucier nor his technical consultant physicist Edmond Dewan had, nor claimed to have, the expertise required to interpret physiological data for diagnostic purposes. Despite the potential intrigue produced for audiences by sonifying biological processes, Lucier's project diverges, at least partially, from the representational methods of Empiricists, in service of his aesthetic interests in music composition. In Lucier's own words:

[I] didn't want to show mind control... Discovery is what I like, not control. I'm not a policeman. I always thought of splicing alpha waves, or cutting them up in a studio... as being a brain surgeon – and I'm not a brain surgeon. So I completely eschewed that form... and let that alpha just flow out, and the composition was then how to deploy those speakers, what instruments to use. (Lucier and Grimes 1986: 59, cited in Straebel and Thoben 2014: 26)

The introduction of biosensors into Lucier's compositional practice required a reconfiguring of his agency within the compositional process, characterized by a shift away from prescribing particular sounds in time, towards constructing the context in which such sounds could be produced. Reflecting years later on his concerns about this unfamiliar approach the night before the premiere, Lucier intimates:

I went to bed that night. I felt really bad. I was very nervous and anxious, because I thought, 'I don't have a structure for this.' I mean, I'm a composer. I should impose some kind of structure, but then I thought, no, brain waves are a natural phenomenon. They should just flow out, and I will trust John Cage to move the sounds from one speaker to another. (Lucier 2001: 29. cited in Straebel and Thoben 2014: 17–18)

Lucier dips into discourse about the 'natural' body on the one hand, while acknowledging instrumental mediation on the other. It is clear from his reflections that what he calls the "natural phenomenon" of brainwaves becomes intelligible only

through multiple compositional interventions. From the activity of the seated performer equipped with an EEG, to the distribution of sounds between speakers by an assistant, brain waves do not, as he suggests above, “just flow out” (Lucier 2001: 29, cited in Straebel and Thoben 2014: 17–18). Although the unpredictable behaviour of brainwaves and EEG signals meant that Lucier could not impose compositional structure in the same way he might usually when using traditional instrumentation, his training and aesthetic as a composer are still integral to the shaping of the event. Rather than being diminished, in *MfSP* Lucier’s compositional authority is distributed in a number of ways—from the interplay between performer and assistant, to the openness of the score, to the de- and re-contextualized technologies and techniques from medicine to music—all inviting re-imaginings of what constitutes ‘musical composition’.

On altered states of consciousness and aesthetic experimentation with biofeedback

Richard Teitelbaum’s approach to using biosensors in music was initially informed by his experience as a research assistant in a study regarding the ability of subjects to sustain alpha activity in the brain over an extended period of time, through the use of aural and visual biofeedback (Teitelbaum 1976). Writing about his own work, Teitelbaum expresses interest in altered psychological states through meditation with biofeedback, drawing inspiration from Tibetan and Chinese practices (Teitelbaum 1976). In composing what he calls ‘biofeedback music’ he notes tension between aesthetic exploration as a composer, versus the need to “select the most efficacious sonic material to complete the consciousness affecting feedback loop” (Teitelbaum 1976). He explains that his role as a “guide” for performers who are “supplying”

biodata is “to gather together the sounds and bio-rhythms into a sound vision which would guide the subjects through a voyage of discovery both internal and external, and to eventual merging in an altered state of consciousness” (Teitelbaum 1974: 45).

Teitelbaum’s understanding of his agency as ‘guide’ for performers is rather different from Lucier’s description of the ‘assistant’ in *MfSP*. Teitelbaum insists that:

The guide must submerge his ego... He enters the feedback loop as one more component in the service of the subject, realizing that person’s vulnerable state. He acts with utmost care, tenderness and love. The subject responds with complete trust. The guide recognizes that the music is being created not for himself, nor for any audience, but solely for the subject. (Teitelbaum 1974: 46)

In Lucier’s *MfSP* the assistant is presented as a technical support to the soloist, at times even instructed by the soloist, but also exercises aesthetic choice regarding sound production through amplification and panning. As Straebel and Thoben describe:

the performance of *Music for Solo Performer* is a subtle play of hidden communication between soloist and assistant. This ensures the quality of the work on the level of musical integrity in terms of musical form (development, contrast, structure, etc.) and sonic surface (interesting sounds, diversity of sounds and rhythms, etc.) as well as on the level of performance with its creation of the image of a solo performer controlling the sounds by the mere activity of his thinking. (Straebel and Thoben 2014: 27)

The introduction of biosensors in Teitelbaum’s compositional practice, as with Lucier’s, required questioning of the boundaries of his role and control as composer, or ‘guide’, in relation to sonic material, performers, collaborators, and public. Teitelbaum’s ‘scores’ for performances with biosensors were system diagrams of the hardware and software setup, leaving the coaching of performers in terms of meditative practice and duration to verbal exchange on a case by case basis.

Teitelbaum notes that in the late 1960s his performances of *In Tune* with Musica Elettronica Viva (MEV) “became highly ‘performed’, expressionistic, even aggressive”

in accordance with the group's aesthetic direction, which he appreciated musically, and yet, he felt that "other aspects of the work—exploring channels of non-ordinary communications and altered states of awareness—seemed to be somewhat attenuated" (1974: 45). For Teitelbaum, using biosensors for sonification and biofeedback to reveal the interior movements of physiology and psychology, versus integrating biosensors as instruments in his ongoing compositional and improvisatory musical practice with MEV, was a source of tension. He reflects how: "This shift further sharpened a contradiction already inherent in the idea of performing an inner directed, meditational piece before a concert audience. For this, and other reasons, we continued to perform IN TUNE only a few more times" (Teitelbaum 1974: 45-47). In identifying the negotiation of value systems between disciplinary tools and techniques, as well as objectives, Teitelbaum points to the haunted boundaries—constituted by exclusion—of the way in which he perceives his own compositional practice with, versus without, biosensors.

On the dynamics of 'control' and 'change' in music composition with biofeedback

Drawing on dynamical systems theory, David Rosenboom seeks to "modify and evolve our characterization of biofeedback" not "simply [as] a method for stabilizing particular behaviors and, thus, as a static equilibrium system" (Rosenboom 1997: 17, 19). He argues that "biofeedback, in its contemporary, sociocultural context, must be viewed as our participation in the 'process of self-reference' of dissipative, autopoietic organisms in interaction with an environment", and suggests "that the Zen-like state associated with achievement of what we may wrongly associate with the word 'control', is, in fact, a striking example of the quality of subjective experience associated with true conscious

participation in autopoietic self-organization” (1997: 17, 19). Elaborating, he states that biofeedback involves:

the circulation of information about functions within an organism in ever widening feedback loops involving the consciousness of that organism, to serve its creative extension, beyond the structure of its own prior self-definition, in the natural meta-evolution of its self-organization dynamics—and not merely as the extension of a conscious control hierarchy. (Rosenboom 1997: 19)

Rosenboom’s articulation of biofeedback diverges from representational approaches to sonification and biofeedback in which subject and media are made to interact through mappings of cause and effect. In this divergence, he challenges the notion of instrumental mediation because, at least in principle, his compositions do not presuppose control-based interactions between a stable human body and the sonifications that reveal its imperceptible state.

Rosenboom notes however that: “achievement of success with biofeedback requires discipline, intense and regular practice, and often meditative skills”, a sentiment echoed by both Lucier and Teitelbaum in relation to their work with biosensors (1997: 22). The question of how one might assess this achievement in the context of music composition and performance, and how that assessment of success might differ from one made in the medical domain, requires the construction of contexts in which these questions can be asked and answered. Touching on the aesthetic and philosophical implications of integrating biofeedback in his compositional practice in the various iterations *On Being Invisible*, Rosenboom shares that:

Though one idea has certainly been that of increasing the palette, bringing previously unconscious processes into conscious awareness and potential use, this work has led to the realization that the stability of natural oscillators [e.g. brainwaves] is such that one can submerge him/herself in them and learn about the relationship between resonance and the idea of initiating action. This has

profoundly influenced my understanding of the meaning of change in my music [...]. (Rosenboom 1982: 3)

As with Lucier and Teitelbaum, the appropriation of biosensing technologies in Rosenboom's compositional practice intervened in aspects of his approach—for example his “understanding of the meaning of change”—reconfiguring his agency and authority as a composer not only *of* but *within* autopoietic systems (Rosenboom 1982: 3).

Rosenboom recently revisited composition with biosensors, premiering a collaborative project called *Ringling Minds* in 2014.¹⁰ *Ringling Minds* explores collective cognition through a technique called “hyperscanning”, in which “several musical listeners are treated as one hyper-brain to investigate concepts about complexity and structural forms manifested concurrently in music and multiple brains” (Rosenboom 2018: web).

Considering the nearly 35 years that elapsed between Rosenboom’s earlier projects with EEGs, and the premiere of *Ringling Minds* in 2014, beliefs about bodies, brains, and biology have inevitably shifted. For example, understandings of neural networks (biological and artificial) have developed significantly from the mid-late 20th century to present day, inspiring approaches to machine learning with far reaching implications in medicine, computer science, and art alike.¹¹ In machine learning, artificial neural networks are modelled in part after contemporary beliefs about the human brain—not as a central command centre, the activities of which might be revealed through

¹⁰ Rosenboom created *Ringling Minds* (2014) in collaboration with computational neuroscientist and musician Tim Mullen and cognitive scientist and performer-composer Alex Khalil (Rosenboom 2018).

¹¹ See, for example this online database (Barok 2019) on art/design projects that use artificial neural networks in machine learning.

sonification—but rather, as a player integral to the distributed activities of the nervous system. In neural networks, learning is conceived as a layered and interconnected process, involving passages beneath and beyond the skin (Aggarwal 2018). In his description of *Ringling Minds* Rosenboom’s emphasis on “collective brain responses interacting in a spontaneous musical landscape” departs, at least metaphorically, from representational uses of sonification and biofeedback, in that intelligibility is not attributed to any singular source.

Conclusion

With the appropriation of biosensing tools and techniques from medicine into music composition, issues related to the medical gaze and instrumental mediation persist. In each domain, desire for *direct* access to the inner workings of the human body has given rise to an arsenal of tactics for the translation and transmission of biodata in visual, aural, and semantic forms. Across disciplines however, the technologies that delimit the purview of the gaze remain invisible in the representations produced, failing to account for that which they exclude from representation. The constitutive exclusions that bound representations of bodies and biodata in different contexts are necessarily different, and subject to continual change, owing in part to shifting beliefs regarding objective expression and aesthetic experimentation within and between diverse disciplinary cultures.

My project in this thesis is not to judge the merit or veracity of different disciplinary conceptions and representations of bodies, hearts, and other such things—who am I, as choreographer, to speak of medicine and music from without? My goal here is *diffraction*—to produce conditions for interference and entanglement between bodies-

of-knowledge (including my own) which have become differentiated, yet remain entangled. In diffractive methodologies it is the illumination, rather than subjugation, of critical “differences-in-the-(re)making” that matter most to cultivating and sustaining cross-disciplinary discourse and collaboration (Barad 2014: 175). In the coming chapter, I continue the discussion of entanglements of bodies-of-knowledge from medicine to art, and elaborate on the notion of critical appropriation in relation my own collaborative practice-as-research.

Chapter 6: The critical appropriation of technologies as artistic practice

Opening Questions: How can the transit of technologies between disciplinary cultures illuminate the ways in which boundaries are continually enacted through the inclusion and exclusion of different people, practices, and knowledges? As choreographer-composer, how do we appropriate critically, interrogating the material-discursive practices that differentiate our knowledges from other knowledges, and our research from other research?

Introduction¹²

Look hard enough at any discipline and you will likely find technologies being used beyond their intended purpose. In the case of artistic practices incorporating new technologies, appropriation from other disciplines is not only common, but is the norm. When a technology moves from one discipline to another, it carries with it traces of the context, ethics and aesthetics of its original intended use, which in turn shape the context of its use in the foreign environment. In this new context, users are free to interact with it in ways that may violate the ethics of its use in its native discipline. Further, prolonged use engenders new ethical and aesthetic considerations, as well as pedagogies and notions of mastery, all of which may be in contradiction to those of its original discipline. This judgement of violation and contradiction is a situated one, however, and can just as easily be made from the perspective of the appropriator of the technology, originary arguments notwithstanding. The discourse between disciplines

¹² Parts of this introduction are drawn from my co-authored article “Critical Appropriations of Biosensors in Artistic Practice” (Naccarato and MacCallum 2017). The full article is included as Appendix B.

that share a technology is necessarily shaped by the differences in approach to, and the value systems that underlie, its use. While perceived naivety or ethical transgression can negatively impact cross-disciplinary dialogue, surprising, non-normative use can also inspire innovation that had been hindered by ethical restrictions. Further, certain technologies can serve as the point of collaboration between fields.

In *Chaosmosis: an ethico-aesthetic paradigm*, Félix Guattari argues that the ethics of a discipline can hinder its progression and lead to its calcification. The introduction of aesthetic considerations in the form of artistic practice can aid in the exploration of the edges of the discipline that may lie in the shadows cast by ethical grey areas.

The incessant clash of the movement of art against established boundaries (already there in the Renaissance, but above all in the modern era), its propensity to renew its materials of expression and ontological texture of the percepts and affects it promotes brings about if not a direct contamination of other domains then at the least a highlighting and a re-evaluation of the creative dimensions that traverse all of them. Patently, art does not have a monopoly on creation, but it takes its capacity to invent mutant coordinates to extremes: it engenders unprecedented, unforeseen and unthinkable qualities of being. (Guattari 1995: 106)

Indeed, initiatives that aim to integrate artists and artistic practices in contexts commonly considered to be outside the domain of aesthetic experimentation may inspire a “re-evaluation of the creative dimensions that traverse” their differenced-yet-entangled bodies-of-knowledge (Guattari 1995: 106). Many such initiatives exist, for example: the National Aeronautics and Space Administration (NASA) Art Program launched in 1962 and still active to present day (Almeida 2017); the National Initiative for Arts and Health in the Military (Americans for the Arts 2015); the King’s Fund for Arts in Hospitals (Nitkiewicz 2019); and the Public Engagement Fund of the Wellcome Trust which supports art and science collaborations related to health research

(Wellcome Trust 2019). Whether or not these initiatives incite, as Guattari suggests, an “incessant clash of the movement of art against established boundaries” depends, at least in part, on sustained resistance to assimilation and colonisation of knowledges and know-how between disciplinary cultures (Guattari 1995: 106).

In some cases the appropriation of technologies may negatively impact communication between disciplines—particularly when the concerns central to one discipline are treated as subordinate to those of the other. From the point of view of a medical professional trained in the normative use of a biosensor (e.g. an EEG or ECG), artistic use can appear naive, obfuscating issues of intent and redirecting the medical gaze from the body to the health of one’s artistic practice. Conversely, the appropriation of artistic technologies as representational modes for medical or scientific data can subjugate elements of the creative process and turn the objects of scientific inquiry into unwitting performers open to aesthetic critique. The point here is not that doctors and artists should not stray beyond disciplinary notions of rigour and expertise. Rather, what I wish to foreground is that cross-disciplinary ventures require care for differences as they come to matter between communities of practice over time.

While design for reuse, co-adaptation, and appropriation has been studied in the field of human-computer interaction (HCI) (e.g. Dix 2007, MacKay 2000, Tchounikine 2016), many of the specialized devices used in the medical field are designed without those principles in mind, and in some cases with intentional opposition to them. Medical ECGs, for example, are well-suited to their diagnostic use and are geared towards presenting doctors and technicians with a representation of their measurements that indexes their training and simplifies their use in typical scenarios. Use outside those

scenarios may require the design of a new form factor, different modes and interpretation of the measured data, and different locations of their representation. The Quantified Self (QS) movement, for example, has in recent years focused on stylish, low-profile wearable devices that present their interpreted measurements without need for a medical professional, typically on a smartphone or smartwatch (Zimmerman 2014, Lupton 2016). A relatively new field, the success of the QS movement is due at least in part to its ability to separate itself from any perceived stigma associated with poor health that earlier uses of wearable medical technology might indicate (Lupton 2016). Indeed, QS as a movement was created by its own redesigns of appropriated technology as much as it was responsible for those same redesigns.

As choreographer-composer working with heart rate sensors, we do not wish to imitate or replicate knowledges from other disciplines. We see the appropriation, (mis)use, and (re)design of sensing tools and techniques in our artistic practice as a means to probe the “mutant coordinates” of our bodies-of-knowledge, “re-evaluating the creative dimensions that traverse” beneath and beyond their boundaries (Guattari 1995: 106). We acknowledge that in venturing from choreography and composition into medicine, computer science, interaction design, and philosophy, we run the risk of transgressing the ethical and aesthetic paradigms that govern notions of expertise and rigour across domains—including within our own. We proceed nonetheless, caring for differences as they come to matter in the relationships between people, ideas, movements, methods, and materials integral to our creative process. We aim to design spaces for cross-, inter-, and trans-disciplinary collaboration that not only accommodate differences between knowledges, but which require the effects produced by these differences to thrive.

In this chapter I interrogate the transit of technologies between disciplines as an opportunity for mutual destabilization—and innovation—of conceptions and representations of bodies and movement. I begin with examples of the use of biotechnologies in performance art as a means to re/configure bodily boundaries, both materially and discursively. I then discuss resonance between value systems in ‘bio art’ and feminist and process philosophies, with regard to the continual processes of entangled-differentiation through which particular bodies come to matter *relationally*. Turning to HCI, I call into question the notion of *interaction* between pre-constituted things, for example humans and computers, and consider discourse about *embodied interaction* and *distributed agency* within and between disciplines such as philosophy, cognitive science, computer science, and arts-based interaction design. In the second half of this chapter I focus on the notion of critical appropriation as it relates to my ongoing collaboration in *III*. Further, I address the notion of *relationality*, and well as that of *listening*, and probe the constitutive exclusions that bound our understanding of the thing-we-call-Relational-Listening in *III*. This chapter builds on the deconstructive examination of the thing-we-call-the-body, and likewise the thing-we-call-the-heart, from earlier chapters, and further illuminates the bleeding of the medical gaze into diverse disciplinary practices of perception over the course of centuries.

Re/making bodily boundaries

On the re/contextualization of biotechnologies in art

The imaginative (mis)use of tools and techniques designed for the re/configuration of bodies at the level of ‘biology’ can serve as a means to probe the material-discursive boundaries of bodies as they have come to matter in particular contexts. The

appropriation of biomedical technologies into artistic practice raises implicit concerns related to the ethical and aesthetic boundaries of disciplinary cultures within and between art, science, and philosophy. For example, artists such as Eduardo Kac, Marion Laval-Jeanter, Benoît Mangin, Marta de Manèzes, George Gessert, and Paul Vanouse—who describe their related yet independent practices as ‘bio art’—explore the making and re/making of the thing-we-call-the-body through the use of technologies and techniques from art and science alike (Kac et al. 2017). In a co-authored “Manifesto” they state that bio art: “literally works in the continuum of biomateriality, from DNA, proteins, and cells to full organisms” such that it “manipulates, modifies or creates life and living processes” and “intervenes directly in the networks of the living” (Kac et al. 2017).¹³ In a similar vein, Australian performance artist Stelarc probes the boundaries of human flesh through the (mis)use of biotechnologies beyond their intended purpose, as evidenced in the various iterations of *Suspensions* (1981), *Extra Ear* (1997), and *Re-wired/Re-mixed: Event for dismembered body* (2015).¹⁴ The theme of ‘circulation’ between bodies—human and nonhuman, natural and artificial, and living and dead—is integral to Stelarc’s work. In his own words: “We live in the time when flesh is circulating and organs are being detached from some bodies and relocated into other bodies. My blood doesn’t only flow in my body, but circulates in other bodies as well” (Stelarc 2009: 1). The chimeric bodies invoked by Stelarc and other self-proclaimed bio artists—bodies which are always-already natural and artificial, human and nonhuman, dead and alive—highlight entanglements of ontological, epistemological, ethical, and

¹³ Kac’s body of work is documented on his website (Kac 2018).

¹⁴ Stelarc’s body of work is documented on his website (Stelarc 2018).

aesthetic concerns within any act of coming to know and represent the thing-we-call-the-body.

French performance artist ORLAN likewise addresses questions of bodily boundaries, re/purposing biomedical technologies in what she calls ‘carnal art’ to intervene in notions of normative beauty and femininity. ORLAN is widely known for her nine surgical interventions, called collectively *La réincarnation de Sainte-Orlan* (1990-1995), in which she had her face surgically re/configured to incorporate characteristics of idealized feminine beauty from the work of five male Renaissance artists (O’Bryan 2005, Clarke 2010). ORLAN stresses that her goal in this project was not to imitate, replicate, or represent characteristics from the selected paintings themselves; rather: “Carnal Art is the work of the self-portrait in its classical sense, but with technological means which are from one’s own time. It oscillates between distortion of figure and reconstruction of the figure. It is inscribed in flesh” (ORLAN [1989]2010: 28). In ORLAN’s work it is not only the practice of plastic surgery that is being re/contextualized from medicine into performance art, but also the practice of portraiture in classical painting that is being reimagined *in* and *as* her performance of bodily un/becomings. ORLAN, as with the bio artists above, troubles the notion of the body as a self-contained ‘thing’, pointing to the entangled ethical and aesthetic practices through which bodies come to matter for particular people in particular ways.

On bodies in process and feminist philosophy

The questioning of bodily boundaries in the work of ORLAN, Stelarc, Kac, and other bio artists resonates with feminist discourse about embodiment since the late 1980s, in particular with regard to the relational agency *in* and *of* bodies—human or otherwise. In

the writings of Lisa Blackman (2008), Judith Butler (1990, 1993), Elisabeth Grosz (1994, 2011), Petra Kuppers (2007), and Erin Manning (2009, 2013), the body is described as a process, unbound by the skin and seeping through multiple, fluid relationships of self, other and environment. Donna Haraway (1991, 1992, 1997), Katherine Hayles (1999), and Rosi Braidotti (2013) theorize cyborg and posthuman bodies that blur boundaries between human/machine, natural/artificial, and biological/computational. Building from the above authors, Blackman calls into question the very notion of ‘biology’—and therefore biologically-determined bodies—arguing that:

bodies are made and remade through the mediation and modulation of biological capacities that are always dynamic and in relationship with what we might term ‘the outside’: machines, practices, technologies, and so forth. In this sense, ‘biology’, or matter, is not an entity but is defined as a relational, dynamic process which is enfolded with the ‘outside’. The use of the term ‘fold’ points towards the complex entanglement and interweaving of the inside with the outside to the extent that it is impossible to make such distinctions or differentiations. (Blackman 2008: 137–138)

Through emphasis on the continual folding of ‘inner’ and ‘outer’ forces, Blackman points to the entanglement of ideologies like biological and social determinism, materialism and constructivism, and phenomenology and positivism—which, as I discussed in Chapter 3, are sustained by the shared assumption that self/other, body/mind, and body/world are separate things that interact.

If we do not assume a pre-constituted body that acts *in* a pre-constituted world *on* other pre-constituted things (other bodies, people, objects, practices, systems), then it is also no longer possible to assume *a priori* difference between such things as the basis for their interaction with one another. Manning problematizes the idea of ‘mappings’ of

cause and effect between bodies and media, asserting that this representational approach:

rarely moves beyond the limits of interactivity. It does not move the relation: it foregrounds mediations between different systems whereby one portion of the system is necessarily preconstituted. In most cases this means working with a stable body-concept. From stable to unstable and back, but never really metastable. New ecologies of experience are rarely created under these conditions. (Manning 2009: 64)

Resisting the notion of pre-constituted bodies that act *in* the world, Manning emphasizes that interaction is not a relation of “body/world, but body-worlding” (2009: 13). Via movement we do not enter space–time—we create space–time—in immeasurable ways:

Movement provokes duration even as duration provokes movement. Measurable quantity is anathema to duration. This is why the displacement itself – the movement from a to b – is not what is essential about movement. Movement is the qualitative multiplicity that folds, bends, extends the body-becoming toward a potential future that will always remain not-yet. This body-becoming (connecting, always) becomes-toward, always with. I move not you but the interval out of which our movement emerges. We move time relationally as we create space: we move space as we create time. (Manning 2009: 17)

Manning’s insistence on the primacy of movement in the relational becoming of bodies, space, and time is not offered in opposition to perceived stillness; rather, Manning points to the “incipiency” of movement—“the movement of the not-yet that composes the more-than-one that is my body” (2009: 13). The incipience of movement is not a measurable outcome in the world, but rather the very processes of entangled-differentiation through which bodies, space, and time become intelligible and available as objects of interaction—subject to analysis and representation in medical, artistic, and computational practices.

On ‘embodied interaction’ in HCI

Only by stilling bodily boundaries—that is, by denying the continual processes involved in their relational becoming—can the effects of the mind *on* the body, or of the body *in* the world, be harnessed for the sake of designing interaction between pre-constituted things. In an attempt to mitigate this concern, the notion of ‘interaction’ is often qualified by expressions like ‘whole-body interaction’ or ‘embodied interaction’, especially in the case of HCI projects related to sound and movement. A key word search for ‘embodied interaction’ in the proceedings of the *Conference on Movement and Computing* from 2014-2017 returns a wealth of results (MOCO 2015), as does the same search in the proceedings for the *Conference on New Interfaces in Musical Expression* from 2010 onwards (NIME Steering Committee 2014). Of papers in these proceedings that discuss ‘embodied interaction’ (EI) in HCI and interaction design, many make reference to Paul Dourish’s *Where the action is: The foundations of embodied interaction* (2004). Dourish adopts a phenomenological perspective to emphasize embodiment as a matter of situated experience, not confined to the physicality of the human body *itself*, but manifest via encounters between animate and inanimate participants in the material world (2004). Likewise, many HCI scholars, some with backgrounds in dance, propose frameworks of EI that are centred on phenomenological analysis of human movement, as well as the use of Laban Movement Analysis to describe movement qualities in computational systems (e.g. Bevilacqua et al. 2011, Fdili Alaoui et al. 2012, Kirsh 2013, Subyen et al. 2013, Françoise et al. 2014, Silang Maranan et al. 2014, Loke and Kocaballi 2016).

What are the effects of the ongoing differentiation between ‘embodied interaction’ on the one hand, and just ‘interaction’ on the other? Why is there a need to assert that a

given design methodology is indeed *embodied*? Perhaps this advocacy for explicit re/framings of interaction as embodied hints at concerns regarding what the *I* in HCI has come to represent (or not), within and between disciplinary cultures.

Although the notion of ‘interaction’ is pervasive throughout publications in HCI journals and conference proceedings, HCI scholars acknowledge that the boundaries of the *I* in HCI are not so clearly defined. In the paper “What Is Interaction?” (2017), Kasper Hornbæk and Antti Oulasvirta review a range of HCI literature from the past decade and identify what they refer to as seven implicit understandings of interaction, each with its own scope and utility; these include: interaction as dialogue; interaction as transmission (of information); interaction as tool use (e.g. mediation); interaction as optimal behaviour; interaction as embodied action; interaction as experience; and interaction as control (2017: 3–7). Drawing on the work of Mario Bunge (1979), they propose that across these paradigms: “interaction concerns two entities that determine each other’s behavior over time. In HCI, the entities are computers (ranging from input devices to systems) and humans (ranging from end-effectors to tool users)” (Hornbæk and Oulasvirta 2017: 11). Of interest here, is that in order to define interaction in its many modes, the authors also define the ‘entities’ that interact, that is, humans and computers.

Following in the vein of my deconstructive analysis of ‘things’ themselves throughout this thesis I wonder, in regard to HCI: where does the human end, and the computer begin? For a given human or computer, what constitutes normative behaviour, such that deviations from this norm can be attributed to interaction with other(ed) things over time? Who gets to determine what does and does not constitute the ‘human’ and the

‘computer’ in the context of HCI? Perhaps it is not only the *I* of HCI that requires questioning, but likewise conceptions of the *H* and the *C*.

Examining differentiated-yet-entangled understandings of humans, computers, and interaction in differentiated-yet-entangled disciplinary contexts may shed light on the constitutive exclusions that bound the *H*, the *C*, and the *I* of HCI. The point here is not to critique, revise, or uphold a particular perspective above any other; rather, examining the effects of the sustained appropriation of the phenomenological notion of embodiment into HCI hints at processes of continual re/configuration of the boundaries of HCI in relation to other fields such as computer science, cognitive science, philosophy, STS, music, and dance—each of which uses the term embodiment in their own ways.

On relationality in dynamic systems

Articulations of ‘embodiment’ in HCI and dance alike draw on discussions of ‘embodied cognition’ in cognitive science and philosophy of mind (introduced previously in Chapter 3). The notion of embodied interaction is closely related to that of embodied cognition as a means to articulate how the boundaries of ‘things that interact’ are continually re/constituted within one’s frame of reference—even as this frame itself is continually re/configured.

In his book *Ethical Know-how: Action, Wisdom, and Cognition* (1992), philosopher/biologist Francisco Varela argues that human behaviour is not an outcome of intentional or reflexive actions and reactions, but rather emerges from an individual’s embodied memory to form a “readiness for action” in each successive moment (1992: 2, 9). He posits that an individual’s impulse to move, for example in relation to

environmental stimuli or biofeedback, is not easily localized in body or mind, but rather materializes via a “coherent global pattern that emerges from the activity of the simple local components, which seems to be centrally located, but is nowhere to be found, and yet is essential as a level of interaction for the behavior of the whole” (Varela 1992: 53).

Varela’s insistence on the difficulty of locating a central control system presents a conundrum for designs of interaction that are based on cause and effect, because without an assumption of *a priori* difference between one self-contained thing and another, the design of interaction between said things is not possible.

Since the late 1980s scholars interested in shifting human/machine relationships have come to emphasize ‘relationality’ within dynamic and autopoietic systems. The notion of relationality is prevalent in the fields of sociology, anthropology, cognitive science, and philosophy, with regard to “contemporary forms of social organization, social collectives, and their many forms of governance and coordination” (Slaby and von Scheve 2019: 4). Jan Slaby and Christian von Scheve highlight desire across these domains to:

[emphasize] the dynamic relationality of affective processes in their embodied and embedded specificity and with regard to their efficaciousness as forceful relations in various local and translocal contexts. Here, affective, cognitive, and volitional elements are inextricably entangled. As such dynamic comportments, affects and emotions are indispensable driving forces in the constitution of practices, forms of life, institutions, groups, and social collectives. (Slaby and von Scheve 2019: 4)

Significant to relational framings is the notion of ‘distributed agency’—not between pre-constituted subjects (human or otherwise)—but rather, as integral to the processes through which bodies, minds, people, objects, times, and spaces become continually

differentiated, and thus recognizable as things that can affect and be affected within a relational system (Rammert 2008, Kockelman 2017).

Bruno Latour's *Actor-Network Theory* has been influential in the fields of STS, anthropology, and interaction design with regard to theorising non-anthropocentric accounts of relationality between human and nonhuman 'actants' in distributed networks (Latour 2005). In a similar vein Graham Harman's *Object-Oriented Ontology* (2018), Matthew Fuller's *Media Ecologies* (2005) and Manuel deLanda's *Assemblage Theory* (2016) challenge paradigms of interaction that focus predominantly on human forms of agency. Fuller and deLanda both draw on Deleuze and Guattari to articulate systems that are inherently multiple, non-hierarchical, and heterogenous, yet irreducible to their constituent parts—that is, rhizomatic. Deleuze and Guattari clarify that:

The rhizome is reducible neither to the One nor the multiple. It is not the One that becomes Two or even directly three, four, five, etc. It is not a multiple derived from the One, or to which One is added ($n + 1$). It is composed not of units but of dimensions, or rather directions in motion. It has neither beginning nor end, but always a middle (milieu) from which it grows and which it overflows. (Deleuze and Guattari 1980: 21)

The focus on decentralised and nonlinear systems in the philosophy of Deleuze and Guattari has resonance with 'dynamical systems theory' and 'chaos theory' as they are employed in mathematics, cognitive science, computer science, and interdisciplinary artistic practices (Newhouse et al. 1980, Thelen and Smith 2002, Brinck 2007, Kellert 2008, Zeraoulia 2012). Furthermore, ideas about artificial neural networks and deep learning—supported by machine learning and artificial intelligence—permeate contemporary discourse about the future of human/machine dynamics (Sarangapani 2006, Sapuan and Mujtaba 2010, Aggarwal 2018).

The use of qualifiers like *embodied*, *distributed*, and *relational* to re-characterize notions such as cognition, agency, and interaction suggests tension within and between disciplinary cultures concerning how the meanings of these terms have become *bound*—bound, that is, by all that is continually excluded from signification within their definition. The coining of hybrid terms like ‘embodied interaction’ and ‘distributed agency’ implies that there is something other than, or prior to that which they foreground—disembodied interaction? non-distributed agency? The implicit negation involved in the act of qualifying something as *this* rather than *that* need not, however, invoke binary difference; rather, all that is excluded from a given understanding of what constitutes the thing-we-call-*this* is integral to the processes of entangled-differentiation through which *this* and *that* come to matter—*relationally*. To repeat from Butler: “oppositions are, after all, part of intelligibility; [...it is] the excluded and illegible domain that haunts the former domain as the spectre of its own impossibility, the very limit to intelligibility, its constitutive outside” (1993: x).

Ideas about embodiment and relationality are certainly not new, nor can they be attributed to a singular discipline or culture, past or present. As the technologies we call ‘embodiment’ and ‘relationality’ traverse disciplinary contexts in philosophy, cognitive science, computer science, and the performing arts, they come to matter via their continual entangled-differentiation with all that they may have been, and all that they may become—never once and for all, but for ‘us’, here and now.

Re/contextualization: On the critical appropriation of technologies in *III*

On the ethics of re/contextualization

In this section, I explore the notion of critical appropriation as it has evolved in my collaborative practice-as-research with composer John MacCallum in *III*. Although I have given examples throughout my thesis of the transit of technologies between disciplines, it is not the act of taking (as making) itself that constitutes *critical* appropriation. By critical appropriation I do not mean the displacement of pre-constituted things, be it objects, concepts, methods, or metrics, from one context to another. Critical appropriation is a sustained process of re/contextualization with no defined beginning or end, and therefore no static measure of ethical transgression. This means that ‘ethics’—in the sense of that which bounds the realm of knowable and doable things in a given context—must be evaluated continuously and relentlessly from within and as part of this context itself. The intentional de- and re-contextualization of technologies from one discipline to another is not an end in-itself, but rather, a means to probe the ethical and aesthetic values that govern intelligibility within a given domain. In our collaborative work in *III*, our use of ECGs is one such probe with regard to understandings and representations of bodies, movement, and time in differentiated disciplinary contexts.

In our work with ECGs, we question what the data being generated represents, in particular with regard to the experiences of performers. Although we have been using ECGs for nearly six years now, we are wary of making assumptions about correlations between the behaviour of a given individual, their heart, and the visual/sonic/haptic interpretations that we generate from ECG data. In order to make claims of correlation,

we would first need to have an idea, even if implicit, of what the things being correlated *are*, in and of themselves. To this end, we have come to wonder:

Is it possible to design—or to choreograph and compose—without first defining differences between ‘things that interact’? Must we make implicit assumptions about differences between things in order to describe and intervene in the ways in which they relate? In our own work as choreographer-composer, what does it mean to craft ‘relationality’ between things like dancers and musicians, movement and sound, bodies and technologies, performers and public, practice and theory, and time and space?

It was via this line a questioning that we came to develop the practice we now call ‘Relational Listening’.

On the relationality of listening

In ‘Relational Listening’ (RL) we employ the term ‘listening’ primarily as a metaphor for sensing and perceiving in general, rather than as an exclusively acoustic phenomenon tied to hearing. Via RL, we probe the entangled processes through which aspects of our context become differentiated *for us*, as the prerequisite for their perceptibility *to us*. More specifically, as we listen we attempt to synchronize our actions with a variable metronome—eliminating differences between our temporalities—and then, we interrogate inevitable moments of divergence between our temporal behaviours as opportunities for aesthetic experimentation.

For example: if you listen to a metronome that is ticking at 60 beats per minute (BPM), you may feel that you can tap along more or less at the same time as each click. The person beside you may be able to tap along with the metronome as well, so the two of you may sense that you are in sync. Now, if the metronome becomes just a little

inconsistent, perhaps distributing its 60 clicks at variable intervals over the course of the minute so that several clicks arrive slightly earlier or later than you anticipated, it may be more difficult to tap precisely with each click. That said, at this speed, the gap between the click and your tap might be so minor that you, and the person next to you, may not even notice. Now if we slow the metronome down to an average of 30 BPM—so more or less every two seconds but variably distributed over the course of a minute—the increased unpredictability of the click-track will likely make your asynchrony with it more obvious. To mitigate this, you may begin anticipating such that you tap slightly before the click, or else waiting to hear the click before you act. In either case, whether you tend to anticipate or follow, you may become aware of some qualitative shifts in your tapping, in terms of speed and attack, as well as in your breath, posture, and overall comportment. As you and the person beside you stick with the task of tapping with each tick, you may also notice brief rhythms that emerge between the moment when you tap, when they tap, and when the metronome ticks (in whichever order). In this series of asynchronous actions, several temporal intervals emerge: the interval between your tap and the click; the interval between your tap and your partner's tap; and the interval between your partner's tap and the click. This is a lot to process as you continue tapping in relation to each click, and as we replace tapping with playing a musical instrument or improvising movement you will surely realize that synchronizing your behaviour with that of the variable metronome is not possible—at least, not if you make the 'margin of error' small enough that the differentiation between multiple, emergent temporalities is generative, *compositionally*.

On reading ECGs

In *III* our use of ECGs is not, in itself, what constitutes critical appropriation. Unlike acts of appropriation between disciplines, that is, taking something from another disciplinary culture and using it in ways that may contradict the ethics and aesthetics of its previous use, critical appropriation is not a singular, intentional act that one can perform. As a diffractive practice, critical appropriation probes the ongoing processes of entangled-differentiation set in motion through the re/contextualization of ‘technologies’ (tools, techniques, taxonomies, theories), such that the constitutive exclusions that bound their value systems may become illuminated. Critical appropriation requires care for *critical difference*, that is, care for the ways in which in the motives, methods, and modes of articulation of different practitioners become differently intelligible, *relationally*.

In our collaboration as composer-choreographer we do not use ECGs because we want to research or represent the electrical activity of the human heart. Despite having read many books about medical ECGs, we do not have the professional training to interpret an ECG for the purpose of clinical examination, nor is this necessary for our artistic practice. In our appropriation of ECGs we do, however, ask questions about what ECGs are designed to measure and represent in medical and athletic contexts. Below, I briefly outline ideas about ECGs as articulated in medical literature, as the basis from which to differentiate our motives and methods with regard to the use of ECGs in *III*.

So, what does an ECG measure? An ECG is a reading of the electrical activity associated with the heart—assuming a particular definition of the thing-we-call-the-heart. Regarding the “physiological basis of the ECG”, Gari Clifford et. al explain that:

The heart is comprised of muscle (myocardium) that is rhythmically driven to contract and hence drive the circulation of blood throughout the body. Before every normal heartbeat, or systole, a wave of electrical current passes through the entire heart, which triggers myocardial contraction. The pattern of electrical propagation is not random, but spreads over the structure of the heart in a coordinated pattern which leads to an effective, coordinated systole. This results in a measurable change in potential difference on the body surface of the subject. The resultant amplified (and filtered) signal is known as an electrocardiogram (ECG, or sometimes EKG). (Clifford et al. 2006: 1)

ECG waveforms are a visual representation of the temporal intervals generated in the course of the polarization and depolarization of the atria and ventricles, as they fill with and empty of blood (Clifford et al. 2006: 7–8). The recognizable pattern of change in the amplitude of the electrical signal over the course of a single heartbeat produces several peaks in the ECG waveform, labelled as PQRST, with R being the most prominent because it has the highest amplitude (see Figure 8 below).

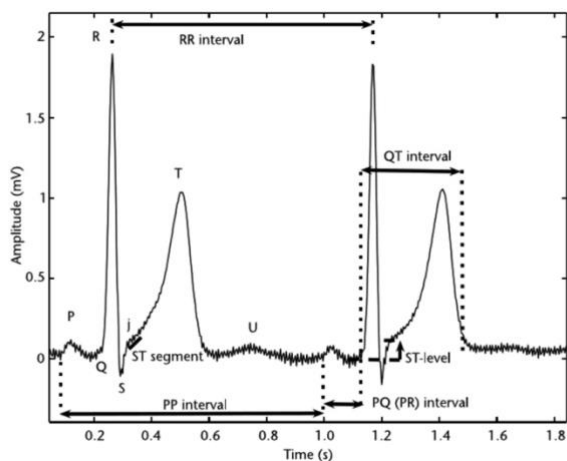


Figure 8: Illustration of an ECG waveform, indicating the amplitude of the electrical signal over time (Clifford et al. 2006: 63)

The interval between one R peak and the next on an ECG is referred to as the “RR interval”, and can be used to interpret the duration of a single heartbeat, as well as average heart rate in BPM over any period of time (Clifford et al. 2006: 60–63). The RR interval oscillates periodically in relation to respiration, shortening during inspiration and lengthening duration expiration, and “each consecutive beat-to-beat, or RR, interval will be of a different length” (Clifford et al. 2006: 61–62). Heart rate variability (HRV)

is calculated based on the variability of the RR interval over time and is related to the behaviour of the autonomic nervous system (Clifford et al. 2006: 61–62). It is this aspect of the ECG signal, that is, its beat-to-beat variability, that has become of particular interest to us as composer-choreographer.

On ‘Relational Listening’ as a ‘thing’ in III

In our ongoing work with performers in *III* we use ECG data to generate variable metronomes that we call ‘click-tracks’. These click-tracks are sonic interpretations of the variable temporal behaviour of the heart from beat to beat. Each ‘click’ in the click-track indicates an R spike in the PQRS waveform. As such, the interval between each click reflects the variability of the RR interval in the ECG signal. We could of course filter out this variability using software, or calculate average HR in BPM and produce a regular beat at this tempo. Both of these strategies are common in off-the-shelf ECG units for sports, as well as ‘smart’ devices like watches and phones for self-tracking. We became interested, however, in the impossible task of coordinating the temporality of one’s own behaviour with the erratic temporality of a sensed process which can never be fully predicted or controlled.

John and I initially developed RL as a means to investigate how we, as composer-choreographer, as well as the dancers and musicians with whom we collaborate, might work in relation to the temporal unpredictability in the ECG signals we were using. At its base, the practice of RL involves a seemingly simple task: listening to and relating with a variable click-track. The training process in RL is highly structured and repetitive, and involves tapping, breathing, weight shifting, and eventually moving, dancing, making sound, and playing music in time with a variable click-track.

Significantly, we found that when listening to minor beat-to-beat variations in a click-track, dancers and musicians were very skilled at glossing over and filtering out anomalies, either by following slightly behind each click, or by ambiguating the moment of execution of their action to produce a wider window of overlap with the arrival of the click. This minimizing of perceptible difference between temporalities—not only for observers, but for performers themselves by way of ‘auto-correction’ based on disciplinary training, was somewhat troubling for us, because they, and we, were essentially washing over moments in which we might investigate our responses to incommensurate differences in temporalities. More specifically, the first strategy (following), subjugates one’s own temporality to that of the click-track, while the latter strategy (ambiguating) obscures and in some cases over-writes the temporality of the click-track in favour of one’s own notion of correctness. While these strategies may be very useful in other contexts, in RL we attempt to un-learn these responses because they undermine the generative destabilization afforded by the impossible task of trying to entrain with the unpredictable behaviour of any ‘thing’ or any ‘one’ that has become other than ourselves. What interests us in RL is the potential that opens up in the interval between our action, and that of any ‘other’—animate/inanimate, analogue/digital, human/posthuman.

Although we came to the practice of RL through our struggle with questions of representation and relationality in our use of ECG data, we rarely use actual sonifications of ECGs until the much later stages of RL training. This is because the beat-to-beat variability of the heart, while always present, can be difficult to discern, especially at higher heart rates in which it becomes less variable (but variable nonetheless). For training purposes, we generate click-tracks using computer software

which exaggerate the variability of the interval between each beat, and thus the ways in which differences between our temporal behaviours come to matter within distributed processes of *composition*.

Finally, it is worth noting that the *tasks* and the *goals* of RL are not the same. Although our tasks involve attempts to reproduce the temporal characteristics of the click-track with our actions, our goal is to explore the ways in which attempts to synchronize generate asynchrony. The asynchrony that inevitably emerges from these tasks does not reveal temporal difference itself; on the contrary, it points to the ongoing processes of entangled-differentiation through which temporal relationships between things become conceivable. While the tasks in RL involve temporal *interaction*, the goal of RL is *intra-action*—a notion I will expand on the next chapter. First however, I will discuss in greater detail how we use RL in our collaboration, as well as the ways in which RL has become differentiated, yet remains entangled with understandings of ‘listening’ in other contexts.

On the constitutive exclusions of ‘Relational Listening’

Consistent with the deconstruction of pre-constituted ‘things’ throughout the preceding chapters—e.g. bodies, selves, objects, subjects, concepts, movements, gestures—it follows that the thing-we-call-Relational-Listening in *III* is not about individual subjects directing attention outwards towards external objects of interest, human or otherwise. Our invocation of the term ‘relational listening’, and likewise the terms ‘relational’ and ‘listening’ in their own right, warrant differentiation from ways in which these notions have come to matter in other contexts, for example in communication studies, philosophy of mind, and music, acoustics, and sound design.

'Communication'

In the field of communication studies 'relational listening' is described as a means to improve interpersonal skills in everyday life, as well as in professional contexts such as social work, psychotherapy, education, and marketing. Building from Carl Rogers' 'empathetic listening' (1975), and John Stewart's 'interpretive listening' (1983), the ongoing discussion of 'relational listening' in communication studies (e.g. Thomlison 1984, Brownell 1994, Halone and Pecchioni 2001, 2012, English 2017) emphasizes the bridging of diverse perspectives to foster mutual understanding and productivity. The paradigm of communication between pre-constituted subjects, as well as the desire to use relational listening to overcome and reduce differences in perspectives, is incongruent with our goals in RL, and in *III* overall. RL involves attending to differences in perception as they are continually re/enacted—even, or especially, in the face of perceived sameness. We are concerned with ways in which differences that have become invisible/inaudible/imperceptible in a given context may once again come to matter, drawing attention to the peripheries of our frames of reference as they are continually re/configured.

'Awareness of awareness'

In the course of each RL session, I give frequent reminders to 'bring awareness to the behaviour of your own awareness'—an instruction that I have encountered repeatedly over the years in training associated with meditation, yoga, contemporary dance, and various somatic techniques like Authentic Movement, Feldenkrais, and Body-Mind Centering. The notion of 'awareness of awareness' is also prevalent in what is referred to as 'philosophy of mind', in particular with reference to the work of Franz Brentano in the late 19th century ([1874]1973, [1887]1995, [1889]1969). Brentano's articulation of

‘awareness of awareness’ has been elaborated over the years by numerous scholars (e.g. Chisholm 1976, 1986, Jacquette 2004, Albertazzi 2006, Kriegel 2016, Martina and Wimmer 2017, Montague 2017a, 2017c, 2017b, 2018, Kind 2019). Brentano was Husserl’s teacher, and beyond the domain of philosophy his influence is evident, if implicit, in fields such as psychology and cognitive science, as well as dance and music, in debate on the significance of sensing, perception, and cognition in the making of consciousness.

In the context of RL our emphasis on ‘awareness of one’s own awareness’ is not a means to study the nature of human consciousness. Although we invite phenomenological reflection following rounds of tapping/breathing/moving/sounding with the click-track, these first-person accounts are not an end in themselves. In RL we emphasize ‘awareness of awareness’ to probe the ethico-aesthetic boundaries of our practices as choreographer-composer, and we invite our collaborators (including audience-participants) to do the same. This is not a matter of directing attention inwards to ourselves or our disciplines as we perceive them, nor is it a matter of directing attention outwards towards pre-constituted things in the world. In RL we do not listen in order to hear or comprehend any one thing itself, nor to identify relationships between one stable thing and another within our frame of reference. Moreover, RL is not aimed at expanding awareness (by some measure), nor at listening more effectively (by some standard). The ‘relationality’ of the listening we refer to in RL is a continual process, always-already underway and without a singular culmination that can be characterised as having failed or succeeded—but this does not mean that *anything goes*. On the contrary, this lack of an identifiable outcome means that the *ethics* of RL—that which

sustains notions of mastery and expertise—can only be evaluated within and *as* the thing-we-call-Relational-Listening itself.

Through our use of the phenomenological notion of ‘awareness of awareness’ in RL we aim to probe the continual re/configuration of our individual frames of reference. RL is a means to deconstruct habitual ways of listening and behaving that have become imperceptible within one’s frame of reference over time. The ongoing de/stabilization of frames of reference is valuable in the context of our collaborative work because it illuminates the bounds beyond which behaviours (human or otherwise) have become invisible to us as *choreographic* and *compositional*.

‘Modes of Listening’

RL is never only about listening *to* something—as if this something could contain or express meaning in and of itself—and yet, we indeed listen *to* variable click-tracks repeatedly in each RL session. The ways in which our conception of RL is differentiated from, yet remains entangled with discourse about listening in music, acoustics, and sound design warrants further consideration.

In the *Treatise on Musical Objects* (1966) by composer Pierre Schaeffer, as well as the *Guide to Sound Objects* (2009) written by Schaeffer’s student Michel Chion, the authors outline four ‘modes of listening’ which have become influential not only in music but in myriad disciplines interested in sound perception and design. The four primary modes of listening initially articulated by Schaeffer include: listening (*écouter*), perceiving (*ouïr*), hearing, (*entendre*), and comprehending (*comprendre*) (Chion 2009: 19). These modes are further characterised as matters of objective/subjective, concrete/abstract, ordinary/specialised, and natural/cultural listening (Chion 2009: 20–26). Drawing on

Husserl's notion of 'phenomenological bracketing' (discussed in Chapter 3), Schaeffer and Chion advocate for "reduced listening", that is, listening practices in which "our listening intention targets the event which the sound object is in itself (and not to which it refers) and the values which it carries in itself (and not the ones it suggests)" (Chion 2009: 31).

In a certain regard our practice of RL can be described as 'reduced listening', in that we ask participants to direct attention to the temporal behaviour of the click-track without concern for the source or meaning of the sound. When listening to the variable click-track in RL, questions about how the audio signal was derived or what it represents (the electrical activity of the heart?... the behaviour of the dancer?... the ECG hardware?... the computer software...?), are irrelevant to the goal of bringing awareness to the behaviour of one's own awareness. The fine-tuned awareness of subtle differentiation that we practice in RL requires a narrow scope of attention, beyond which other ways of listening are inevitably excluded. On the other hand, although RL involves 'reduced listening', we do not do so as a means to point to the aesthetic dimensions of the sound *itself*, nor to our own awareness *as an end in itself*. In RL the click-track becomes significant by virtue of its role in shaping a context in which relational behaviours emerge.

'Deep Listening'

The 'reduced' and repetitive character of our listening tasks in RL may also be likened to activities involved in Pauline Oliveros' *Deep Listening* (DL), however our goals diverge (Oliveros 2005). Oliveros proposes that "Deep Listening is a practice that is intended to heighten and expand consciousness of sound in as many dimensions of awareness and attentional dynamics as humanly possible" (2005: xxiii). She describes

the “training exercises” as involving “energy work, breath exercises, vocalizing, listening and dreamwork” (2005: 1). Through repetition, these exercises are meant to “promote the appropriate attitude for extending receptivity to the entire space/time continuum of sound”, which, she argues: “is essential for creative activity in the arts and can be applicable to any discipline” (Oliveros 2005: 1). As with Schaeffer and Chion, Oliveros makes a strong distinction between *hearing* as “the physical means that enables perception” in the ear itself, and *listening* which “takes place in the auditory cortex” and requires “attention to what is perceived both acoustically and psychologically” (2005: xxiii). Further, she argues that “sound pressure patterns assist hearing but cultural history and experience influences listening” (Oliveros 2005: xxiii). In RL and in our collaborative work in *III* overall we do not draw *a priori* distinctions between hearing versus listening, perception versus cognition, and physiological versus cultural influences. RL is not aimed at deepening or “extending receptivity” (Oliveros 2005: 1), but rather, at interrogating the ways in which ‘reception’, and likewise ‘receiver’ and ‘received’, are always-already relationally constituted. Whereas *deepening* implies a movement inwards or into—the penetration of meaning within a thing—the continual movement of *relationality* is not easily localizable. The *relationality* of RL is “a transversal movement that sweeps one and the other away, a stream without beginning or end” (Deleuze and Guattari 1980: 25).

In my attempt to differentiate Relational Listening from Deep Listening, as well as other practices discussed throughout this section, I am confronted with the constitutive exclusions through which RL signifies as a practice *itself* in the context of my collaboration and beyond. In order to express what I think RL *is* and *does*, I spent much time considering what RL *is not* and *does not do*. In probing the boundaries of the thing-

I-call-Relational-Listening, my goal is not to distance it from other practices, nor to critique other practices which serve different goals in different contexts. The ways in which I articulate the notions of ‘relationality’ and ‘listening’, in relation to Relational Listening, expose what matters to me in the context of our ongoing collaboration in *III*.

Conclusion

Our sustained collaboration in *III* is a process of relentless deconstruction of the values that circulate *in* and *as* our bodies-of-knowledge. We deconstruct, in order to probe the material-discursive processes of differentiation through which things become one such thing—one body, one sensor, one practice, one theory—and not any other. In *III* we are not concerned with difference *in-itself*, because no such thing exists. Rather, we are concerned with the ways in which different differences come to matter differently for different people in different contexts. We are curious about instances in which the perceived significance of differences—as processes of differentiation—manifest differently for different people sharing the same context. In other words: how do we perceive the significance of the *same* difference differently?

Our use of the qualifiers *relational* for listening, and *critical* for appropriation are attempts to foreground aspects of these practices that have come to matter to us in our collaboration, and which may diverge from common uses of these terms. Relational listening need not be understood in binary terms with non-relational listening (which surely does not exist), nor should critical appropriation be understood as the antithesis of cultural appropriation. The significance of these terms, and the practices they represent, is contingent on their ongoing entangled-differentiation with one another, and with myriad other *others* in the contexts in which they perform.

In the next chapter I consider the continual differentiation-yet-entanglement of the notions of *interaction* and *intra-action* in discourse about the thing-we-call-the-body and the thing-we-call-the-heart, within and between disciplinary cultures.

Chapter 7: Collaboration as differentiation: Rethinking interaction, intra-actively¹⁵

Opening Questions: How can we rethink interaction *intra-actively*, that is, without assuming pre-constituted ‘things that interact’? Likewise, how can we approach collaboration *diffractively*, that is, with care for differences as they become critical?

Introduction

What matters is marked off from that which is excluded from mattering but not once and for all. Intra-actions enact specific boundaries, marking the domains of interiority and exteriority, differentiating the intelligible from the unintelligible, the determinate from the indeterminate. Constitutive exclusions open a space for the agential reconfiguring of boundaries. (Barad 2007: 181)

The design of interaction between things—between the body, heart, brain, and soul, between dancers and musicians, between choreographer and composer, between author and reader—requires the production of a frame in which these things become conceivable as discrete things in relation to other such things. In this chapter, I build from the discussion of the ontological uncertainty of the thing-we-call-the-body, and likewise the thing-we-call-the-heart in the earlier chapters, redirecting my gaze towards the thing-we-call-interaction. I revisit the notions of diffraction and critical appropriation as a means to reimagine interaction ‘intra-actively’, that is, in terms which do not presuppose originary difference between pre-constituted things, but rather account for the processes of entangled-differentiation through which things become

¹⁵ This chapter is based on my co-authored publication with John MacCallum in the *Journal of Performance Philosophy*, by the same title (MacCallum and Naccarato 2019). This article is included in full as Appendix D.

available for interaction within the frame of reference of a given designer—implicating the designer in the design itself.

My interest in the notion of ‘interaction’ stems from my long-standing collaboration with composer John MacCallum. As composer-choreographer, we create work for stage and installation that is often described as ‘interactive performance’, perhaps owing to our use of technologies for biosensing and motion-tracking. Through our appropriation of technologies from other disciplines, we have become implicated in cross-disciplinary discourse regarding interaction, and interaction design. In this chapter, I write together with John to address themes from throughout my thesis in relation to our long-term, collaborative practice-as-research. The text in this chapter is based on our co-authored article in the *Journal of Performance Philosophy* (MacCallum and Naccarato 2019), which is included in its entirety in Appendix D. I have made minor revisions and cut and added materials as needed to facilitate its potential for diffraction with other chapters in the context of this thesis. The decision to include this text, nearly in its entirety, can be understood as an act of appropriation from a collaboration external to this thesis. I cut, shape, and take, but with ultimate responsibility for those actions. While the content contained in the text below contributes to the body-of-knowledge that is this thesis, so too do the techniques with which John and I deconstruct our authority to produce and represent that content. From this point onward in this chapter, John and I will speak together as a ‘we’, as choreographer-composer or composer-choreographer, interchangeably.

Wherever you are, imagine three other people sharing the space with you. They are seated on the floor, legs crossed, backs straight, eyes closed, hands on knees, wearing loose-fitting skin that is not their own. They are breathing slowly and calmly but deeply and audibly. They are wearing headphones that indicate when to inhale and when to exhale. Their breath is regular; they take precisely six seconds to fill their lungs to capacity, and then another six seconds to completely void their lungs of air. Take a few breaths with them...in for six seconds...out for six seconds...in...out. It's ok if the imposed regularity of the clock is uncomfortable, it's supposed to be. This is not normal involuntary breathing, nor is it Pranayama, nor is it recovery from physical exertion. It's an exercise in aligning a bodily process to one of mechanical regularity.

Prelude: Choreography, composition, and interaction

In our discussion of 'interactive performance', we must acknowledge from the outset that we do not believe there is such a thing as performance without interaction, or performance without technology. We employ the terms 'interaction' and 'technology' in their broadest senses and with intentional ambiguity to evoke the multiplicity of meanings they perform in different disciplinary contexts (music, dance, computer science, physics, chemistry, statistics). This text is an attempt to interrogate assumptions regarding interaction within our own and other disciplines as a way of caring for our relationship to these fields. Our interest here is not to define interaction, nor to challenge or critique existing interpretations of the term. We also do not desire a common language across disciplines, such that we may design interaction together in a way that we all appear to understand, at the expense of collapsing the specificity of our different perspectives. As choreographer-composer traversing disciplinary cultures, what we are after, really, are strategies for cross-disciplinary collaboration that resist subjugation of viewpoints and that not only tolerate, but rather require *critical* difference between practices to thrive.

We begin by arguing that the concept of ‘interaction’ can only take on meaning in a situated context and is therefore an object subject to design. We look to Barad’s notion of ‘intra-action’ as a way of framing the process of constructing concepts such as ‘interaction’ and ‘things that interact’, as well as the concept of ‘intra-action’ itself. Finally, we foreground our practice of ‘critical appropriation’ in which we assert that all use of technology (broadly construed) involves appropriation—an act of taking and making our own. Sustained attention to the ongoing act of appropriation, always-already underway through use, is a practice of care for the multiplicity of that which is being used, and more generally, a practice of care for difference.

Move closer to one of the breathers, and sit down on the floor so that your knees are almost touching theirs. Really try to match the regularity of the breathing of the person directly in front of you. Now reach into the chest of this person. Through the skin that is not theirs, between the bones, and find their heart. Hold it with both hands as you continue to synchronize your breath with theirs.

Haunted boundaries [of objects]

Composers, choreographers, architects, engineers, city planners, HCI designers, all construct ‘technologies’ (public spaces, machines, software, choreography, buildings, compositions) that restrict and encourage different types of behaviour in time. Across these and myriad other disciplinary practices, the approach of any designer to shaping relationships between ‘things’ (e.g. bodies, data, ideas), positions the designer in relation to these things as objects of interaction, without precluding the designer being one of these objects. This design process is grounded in understandings of what these

things *are* as objects of interaction, and therefore, what they *can do*, that are rooted in the conceptual frame and intentions of the designer. Many aspects of this conceptual frame may remain tacit and implicit throughout the design process—ideas about humans, non-humans, bodies, machines, technology, interaction, computation, space, time, gender, race, etc. Approaching interaction design by engaging in processes intended to make these aspects of the conceptual frame, and the values that underlie its construction, explicit, offers opportunities to treat the constitutive differences as objects themselves in the design process.

We propose that interaction design be coupled with *intra*-active design, i.e. a continual process of explicitly engaging in the local production of subjectivity, and which positions the interaction designer as an entity in the context of interaction. The notion of ‘intra-action’ is not offered here as a replacement for, or redefinition of ‘interaction’. Each of these concepts only becomes meaningful through its situated use and utility, which is defined, in part, by its continual differentiation from the other. By differentiating between interaction and intra-action we do not arrive at a binary explanation; rather, the concepts of interaction and intra-action only come to matter *intra-actively* in a given design practice. Interaction and intra-action become entangled in any examination of the ways in which the value systems of the designers have become inscribed within the technologies and techniques of an interactive system. For example:

Imagine that we wish to design a device like the Microsoft Kinect—an array of cameras and microphones with a microprocessor that produces an estimate of the number of human bodies in its field of vision and a representation of the positions of the joints of

those bodies. During the design process the designers must answer, implicitly and/or explicitly, questions concerning what constitutes a human body and how it will be represented. Does it have four limbs? If not, how many can it have? Can it be in a wheelchair? A bed? What types of clothing can it be wearing? The designers also must ask where a body can be—can it be outside? Underwater? Is the body free to move through the same physical space as the device we are designing, or is it encumbered by the limits of the field of vision of the cameras? Answers to these questions, and no doubt a host of others, describe what bodies *are* and *can do* from the viewpoint of the object to be designed. As the object is built, these *descriptions* become *inscribed* in the hardware, software, operating instructions, training videos, etc., and ultimately produce a set of *prescriptions* for *how*, *where*, and *what* to be and do if one wishes to be identified as an object of interaction in this context.

These prescriptions delimit the boundaries of a community populated by those who are able, willing, and interested to participate in interaction as put forward by the designers of a given technology. They are the foundations of culture, discipline, knowledge, and power in this community, and construct the group of objects available for interaction, as well as the locally-derived notion of interaction itself. In the coming pages, we shift our focus from the design of interaction between ‘things’ to the situated design of the culture organizing ‘things that interact’. This requires attention to those aspects of interaction design concerned with the construction of boundaries for the purposes of organizing ‘things’ as objects of interest.

Cultures and their constituent parts, disciplines, knowledges, subcultures, politics, conflicts, etc., are not stable, and cannot be represented in their totality through any

means. The process of referencing a community, a culture, a discipline, is a process of stabilization through various forms of in-, ex-, oc-, and -transclusion. This process is the construction of a social object belonging to the community engaged in observation and reference; to say that this object is distinct from the community being observed would be to engage in a second processual construction of a community as a social object. Such an object, related to Durkheim's concept of a 'social fact' (1982), is itself a process in relation with those engaged in its construction, and, as such, may not be referenced or represented in its totality. The relationship of these societies with those who construct them depends on the ways in which their borders have been designed to include, exclude, occlude, or transclude their designers.

Butler points to the haunting of constructed borders by all that has been rendered invisible, yet remains (1993: 8). The absent presence of objects of non-interest is what stabilizes interpretations of objects of interest within a locally-derived system of interaction. That which constitutes a body in the eyes of the Kinect (or more generally, that which constitutes a body or object of interest in a system of classification), is set against that which it views as lacking bodily coherence, a view that overlaps with that of the designers. This body and other-than-body require one another in order to differentiate their ontologies through an ongoing process of constitutive constraint, which is never resolved once and for all. It warrants consideration then: "is it still possible to raise the critical question of how such constraints not only produce the domain of intelligible bodies, but produce as well a domain of unthinkable, abject, unlivable bodies?" (Butler 1993: xi). Through their shared becoming, bodies of interest and bodies of non-interest remain entangled and intra-active, resisting binary designation, and threatening the sovereignty of the local system of interaction. The

‘filtered-out’ bodies, gestures, and ‘noise’ of an interactive system remain integral to the coherence and operation of that system.

When the sanctity of the objects of interest is undermined by the absent presence of their obligatory others, the designer must look beyond the discretized frame of interaction, towards the continual field of intra-action of which they themselves are part.

Bring your attention to the gradual changes in tempo of the heart you are holding. Speeding up as the lungs are filled, slowing down as the breath is released. Stay here for a moment, just focusing on the gradual shifts in tempo of the heartbeat with the breath.

Now bring your attention to the pulses themselves, those movements that fill your hands and produce tempo. Feel the ways each beat marks and divides the breath, and the ways the breath groups the beats. Perhaps those groups begin to take on character, shape, meter.

Take note of moments when a beat happens to occur at the moment of a transition from an inhale to an exhale, or an exhale to an inhale. Or a beat that happens to perfectly divide the breath into equal halves.

Now bring that same attention to the beats that fall in relations with the breath that are not so simple to categorize. Moments when the beats seem to be floating against the metrical regularity of the breath, before they lock back in briefly, only to float away again.

Intra-active design as collective subjectivation: From causality to entanglement

As discussed briefly in earlier chapters, ‘intra-action’ is a neologism coined by Barad which she describes as signifying “the mutual constitution of entangled agencies” and

can be understood as shifting the focus from the individualistic notion of things interacting and cause/effect dualism to the material-discursive production of subjects and objects that intra-act (2007: 33). She elaborates:

In contrast to the usual ‘interaction’, the notion of *intra-action* recognises that distinct entities, agencies, events do not precede, but rather emerge from/through their intra-action. ‘Distinct’ agencies are only distinct in a relational, not an absolute sense, that is, agencies are only distinct in relation to their mutual entanglement; they don’t exist as individual elements. Importantly, intra-action constitutes a radical reworking of the traditional notion of causality. (Barad 2010: Note 1, 267, orig. italics)

While discourse about interaction, itself a thing, requires ‘things that interact’, discourse about intra-action involves processes of stabilization and destabilization (of these processes), the continual making and unmaking of things. Whereas things like interaction are often visualized using arrows to represent information moving from one object to another, an aspect of intra-action concerns the way in which those arrows and their directionality get constructed—the notion of cause and effect is replaced by entanglement.

Similar ideas can be found in the writings of Deleuze and Guattari:

Mimicry is a very bad concept, since it relies on binary logic to describe phenomena of an entirely different nature. The crocodile does not reproduce a tree trunk, any more than the chameleon reproduces the colors of its surroundings. The Pink Panther imitates nothing, it reproduces nothing, it paints the world its color, pink on pink; this is its becoming-world, carried out in such a way that it becomes imperceptible itself... (Deleuze and Guattari 2005: 11)

It is not enough here to reverse the arrows and say that the tree trunk reproduces the skin of the crocodile—that is simply a judgment made from another perspective framed by mimicry, imitation, reproduction, evolution, etc. Another way to say this is that the chameleon is a process in continual change (becoming), and as such cannot be represented through any means, material, discursive, or otherwise. When we label it

“the chameleon” and discuss what it may or may not be doing when it changes colour, we have produced a necessarily incomplete representation of it—a new object—that omits an infinitude of aspects that fade into imperceptibility. What was omitted was done so due to our context, our frame of reference, and our current set of intentions concerning our construction and use of the chameleon (*i.e., making a point in this text*).

Conceptual shifts such as these are radical as they are invitations to uproot the settled knowledge and resolved disputes of a discipline, to probe those aspects of disciplinary knowledge that ground practice. Just such a shift formed the basis of the approach to what Félix Guattari and Jean Oury referred to as “institutional psychotherapy” as practiced at the psychiatric clinic of La Borde since the 1950s where “everything there is set up so that psychotic patients live in a climate of activity and assume responsibility, not only with the goal of developing an ambience of communication, but also in order to create local centres for collective subjectivation. Thus it’s not simply a matter of remodeling a patient’s subjectivity—as it existed before a psychotic crisis—but of a production *sui generis*” (Guattari 1995: 6). This approach has profound implications not just for the working methods of the institution, but the institution itself: “one could not consider psychotherapeutic treatment for the seriously ill without taking the analysis of institutions into account. Reciprocally, the conception of individual treatment came to be revised, bringing greater attention to the institutional context” (Guattari 2015: 61). Guattari’s views represent a turn away from individualism:

So we are proposing to decentre the question of the subject onto the question of subjectivity. Traditionally, the subject was conceived as the ultimate essence of individuation, as a pure, empty, prereflexive apprehension of the world, a nucleus of sensibility, of expressivity—the unifier of states of consciousness. With subjectivity, we place the emphasis instead on the founding instance of

intentionality. This involves taking the relation between subject and object by the middle and foregrounding the expressive instance. (Guattari 1995: 22)

In the context of interaction design, “taking the relation between subject and object by the middle” requires letting go of interpretations of mimicry and causality between pre-constituted things. Only through their differentiation within processes of subjectivation and intra-action do discrete things *become*, and therefore become available as objects that can be made to interact.

Continuing to stay attentive to the complex temporal relationship between the breath and the heart, begin to imagine the hearts of the other two breathers in the room with you. Imagine that although their breathing is the same as the person in front of you, and their hearts follow similar patterns of acceleration and deceleration, the three of them produce a complex counterpoint of pulses out of which you find yourself in the continual process of making and unmaking rhythmic patterns, all against the cantus firmus of the breath.

Interlude: What-we-mean-by-interaction

We pause here to bring awareness to our own process of weaving together appropriated passages of text by immanent philosophers in order to construct a narrative that is ours, not theirs, and designed to convince you the reader to consider our frame of reference.

These authors and passages have been chosen strategically not just for the profundity of their ideas, but with full knowledge of our use of their discursive gravity as a technology of power. “My inhibitions, as you can see, can be expressed only by being dressed up in external statements, and now that I am using quotations as weapons of debate, I will offer some more in the hope of salvation” (Guattari 2015: 208):

Discourse is not what is said; it is that which constrains and enables what can be said. Discursive practices define what counts as meaningful statements. Statements are not the mere utterances of the originating consciousness of a unified subject; rather, statements and subjects emerge from a field of possibilities. This field of possibilities is not static or singular but rather is a dynamic and contingent multiplicity. (Barad 2003: 819)

Discourses are not once and for all subservient to power or raised up against it, any more than silences are. We must make allowance for the complex and unstable process whereby discourse can be both an instrument and an effect of power, but also a hindrance, a stumbling block, a point of resistance and a starting point for an opposing strategy. Discourse transmits and produces power; it reinforces it, but also undermines and exposes it, renders it fragile and makes it possible to thwart it. (Foucault 1990: 100–101)

To what extent does discourse gain the authority to bring about what it names through citing the conventions of authority? And does a subject appear as the author of its discursive effects to the extent that the citational practice by which he/she is conditioned and mobilized remains unmarked? Indeed, could it be that the production of the subject as originator of his/her effects is precisely a consequence of this dissimulated citationality? (Butler 1993: xxi)

This chapter (and this thesis) may be described as a contribution to this or that field, however, in consideration of the frame of reference established in previous chapters, we must acknowledge the inherently intra-active nature of any such contribution. We see this work as a contribution to the discourse intended to shape the contexts in which conceptions of ‘interaction’ and ‘things that interact’ are produced. The production of a definition of ‘interaction’ is the production of subjects included within the boundaries of that definition, as well as the domain of the excluded, who come to haunt that boundary. The design of interaction necessarily includes becoming subject to ‘what-we-mean-by-interaction’.

Intra-action is related to collective modes of work such as collaboration, cooperation, coordination, teamwork, etc., but generalized to take into account that these notions

themselves are produced through intra-action and that the participants, human or otherwise, are never stable, but are in continual processes of becoming and unbecoming. Intra-action can be seen as the dark matter that binds these continually changing, partially understood objects together in an ontogenetic becoming-universe.

The primary question with which we are concerned is how, and to what extent, we may design that universe, and what is at stake in the choice of different approaches. In the following sections, we investigate the notions of diffraction and critical appropriation as potential approaches to intra-active design.

Return your attention to the pulsing heart in your hands.

Is this a boundary object?

In the social sciences broadly, and HCI and STS specifically, the concept of ‘boundary objects’ is often deployed to describe and facilitate interaction between communities. Introduced by Susan Leigh Star in 1989, the concept was also intended as a provocation to the artificial intelligence community to reconsider notions of what constitutes intelligence from the standpoint of cooperative work in open systems. The following year, Star and James Griesemer refined the concept, demonstrating and advocating its use as an analytical tool to frame the cooperative actions of the players involved in the early years of UC Berkeley’s Museum of Vertebrate Zoology (Star and Griesemer 1989). By way of a definition, Star and Griesemer offer the following:

Boundary objects are objects which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual-site use. These objects may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation. (Star and Griesemer 1989: 393)

Star and Griesemer write that the production and management of boundary objects “is a key process in developing and maintaining coherence across intersecting social worlds” (1989: 393). Isto Huvila goes a step further, stating that they “are a precondition for communication, cooperative work, and having reached mutual goals” (2011: 3). Star and Griesemer describe boundary objects as an expansion of what Michel Callon called ‘interessement’: “Interessement is the group of actions by which an entity [...] attempts to impose and stabilize the identity of the other actors it defines through its problematization. Different devices are used to implement these actions” (1986: 8). While these two analytical approaches are similar, Star and Griesemer emphasize the construction and use of objects that get created to negotiate the boundaries between viewpoints rather than the processes of translation of information as it crosses boundaries.

For Star, the term ‘object’ is meant to be understood in a variety of pragmatic, disciplinary, and material senses, as:

something people (or, in computer science, other objects and programs) act toward and with. Its materiality derives from action, not from a sense of prefabricated stuff or “thing”-ness. So, a theory may be a powerful object. Although it is embodied, voiced, printed, danced, and named, it is not exactly like a [heart] that has four [chambers]. A [heart] may be a boundary object [...]. (Star 2010: 6, orig. italics)

The point being made here is that the materiality of an object, be it a theory or a heart, does not determine whether or not it is or can be a boundary object. Rather, it is the differential materialization of this object through its performance within overlapping systems and worlds, always underway and always in relation to the materialization of other objects, that informs interpretations of it as a boundary object.

Imagine a healthy, beating heart, fully functional in its capacity as an organ sustaining life in a young pig. In this capacity, it sustains the basic biological systems of the body, but also requires those same systems in order to function. Now imagine the heart, i.e. the muscle, cut from those systems and removed from the pig. Displaced from its role in the sustenance of the body in which it was grown, it is now free to be used in other ways, as food, as an object in a piece of art, or perhaps even, as seems likely at the time of this writing, it may find use as a functioning heart again, ensuring the longevity of a being from another species. The specific heart that we are imagining was one that was bought from a triperie in Nice; it was intended to be sold for food, and indeed, we intended to eat it, but only after filming it as an object of choreography. We spent two days exploring and filming intimate touch with each other and the heart, after which, we could no longer imagine the heart in its capacity as food.

So, is this pig's heart a boundary object? This question requires the construction of a context in which this question matters. We could discuss its role in terms of Capitalism, the geopolitics of meat consumption, animal rights. We could also discuss it in terms of its role in shaping the exploration of touch and movement in an artistic context between two people with different disciplinary backgrounds. We can also see the construction of the pig's heart through description and recollection for the purpose of arguing that

boundary objects are always constructed a posteriori in order to shape the viewpoint of a peer group, rather than through use as suggested by the literature. There is a grave risk for us here that one day you may encounter the short film in which we handle the pig's heart and see it as an example used to make a claim about boundary objects, or worse, you may think that it was produced with that purpose in mind (we assure you it was not).

The point being made here illustrates a bifurcation of a boundary object into an object constructed through cooperative work, and an analytical object used to describe said work. An ethnographer studying cooperative work is also implicated in cooperative work. For the people under study, theories and other 'things' have the potential to become boundary objects in the context of their cooperative work. However, when described as such by the ethnographer, these objects, along with the people that use them, may also become boundary objects in the production of knowledge between the ethnographer and the ethnographer's peer group. This is to say that the construction of a boundary object to describe aspects of collective work becomes a boundary object in the collective work practice of description. In Callon's study of the different parties involved in the preservation of sea scallops in St. Brieuc Bay, he astutely implicates the disciplinary peer group that the Japanese researchers are affiliated with as contributing to the intentions of the researchers (Callon 1986). Similarly, in order to situate this discussion of boundary objects in a larger discourse, we must implicate ourselves as part of the peer group associated with Star, Griesemer, and those others who contribute to the production of knowledge related to boundary objects.

In this very text, we appropriate the concept of boundary objects—which itself can be used as a boundary object—and employ it in order to question the capacity of boundary objects to support approaches to cross-disciplinary collaboration that not only tolerate divergent viewpoints, but that require divergent viewpoints to operate and flourish. As a potential boundary object, this paper is part of a context of intra-action that includes other publications about boundary objects that are themselves potential boundary objects.

Bring as much of the palms of your hands and your fingers into contact with the surface of the heart as you can. Try to envelope it fully so that you can feel as much of the subtle complexity of its movement as possible. Let the discreteness of 'beats' dissolve into continuous and continual waves of pulses. Feel them travel across, through, between your hands. Try to imagine that in the smallest movements, the ones barely perceptible, the heart is gathering the energy it needs to beat. Now imagine that you can increase that energy by squeezing it in those moments between the beats, pushing energy into the heart, and receiving it back in your hands when it beats.

Haunted boundaries [of boundary objects]

Star and Griesemer assert the “fundamental sociological finding” (1989: 388) that consensus is not necessary for cooperation; however, their text belies the belief that some form of reconciliation of differing viewpoints is necessary for cooperation:

Consensus is not necessary for cooperation nor for the successful conduct of work. [. . .] However, scientific actors themselves face many problems in trying to ensure integrity of information in the presence of such diversity. [...] When the worlds of these actors intersect a difficulty appears. The creation of new scientific knowledge depends on communication as well as on creating new findings. But because these new objects and methods mean different things in different worlds, actors are faced with the task of reconciling these meanings if

they wish to cooperate. This reconciliation requires substantial labour on everyone's part. Scientists and other actors contributing to science translate, negotiate, debate, triangulate and simplify in order to work together. (Star and Griesemer 1989: 388–389)

The characterization that diversity causes problems, that the intersection of worlds creates difficulty, situates the concept of boundary objects as the key to reconciling these meanings so that communication can occur and new scientific knowledge can be created. Boundary objects are positioned as passage points through which information must flow for cooperative work to produce knowledge. What a reconciliation of viewpoints implies, and the ways it differs from consensus, has been examined by Huvila who writes that: “the creation or reshaping of a boundary object is always an attempt to make a hegemonic intervention” (2011: 21). He elaborates:

the boundary object and boundary crossing have a purpose. This purpose, even a very lenient one, is an attempt to influence adjacent communities and as such a more or less belligerent form of hegemonic intervention. [...] A specific characteristic of a boundary object is that it makes hegemonic interventions easier to accept for communities with antagonistic tendencies even if the emerging norm would be advantageous by default only from the point of view of the hegemonic position. Boundary objects may thus be seen as facilitators of hegemonic interventions of different levels embedded in the boundary practices of interfacing communities. (Huvila 2011: 21)

The construction of this hegemonic relationship is the construction of a particular type of interaction, which itself occurs in the context of intra-action and the production of truth/power. While the subjugation or assimilation of viewpoints as they funnel through the passage point of the boundary object may be consensual or even welcome, the dynamics of boundary crossing cannot be interpreted outside of the operation of disciplinary power. What Huvila is effectively proposing is a category of boundary objects that we might call ‘hegemonic boundary objects’ that are used to conduct and describe collective work that is based in particular assumptions about productivity

rooted in Capitalism. The production of these hegemonic boundary objects in analytical discourse reflects the analyst's frame of reference, intra-active context, and operations of power. Actions are not themselves *a priori* hegemonic in nature; the determination that an action is or was hegemonic is a situated one that requires the production of a subjectivity in which the action becomes hegemonic.

While our purpose here is to highlight the subjective nature of such a determination in order to invite discourse about other possible subjectivities, doing so pushes us into delicate ethical territory where questions of accountability and responsibility must be raised, both with respect to the act deemed hegemonic, and the act of deeming an act hegemonic. The proposition that these determinations are situated in one's subjectivity does not imply absolution of responsibility; on the contrary, their production is entangled with questions of responsibility. Responsibility requires things to be responsible to, and the production of those things cannot be distinguished from acts of responsibility.

In a similar vein to Huvila's account of boundary objects as hegemonic interventions, Kathryn Henderson describes 'conscription devices' as visual representations used to enlist and organize participation in collective work. She states: "Since visual representations are located at the center of power, they are the locus of action, which may be negotiation and consensus, or it may be conflict and power plays" (1999: 134). This notion of power, limited in its conceptual and geographic reach by its ocularcentrism, is very different than Foucault's articulation of disciplinary power as a "total structure of actions brought to bear upon possible actions" (1982: 789). Power cannot be reduced to control. The characterization of power as a central hub (i.e. a

conscription device), that mediates between the interests of parties during interaction, is a colonialist narrative: it fails to acknowledge the continual, intra-active construction of the haunted boundaries of these objects, as well as the infrastructures they traverse.

Elaborating on the concept of boundary objects, Bowker and Star discuss “boundary infrastructures” as “objects that cross larger levels of scale than boundary objects” to “deal with regimes and networks of boundary objects (and not of unitary, well-defined objects)” (Bowker and Star 1999: 313). They explain that, “[w]hat we gain with the concept of boundary infrastructure over the more traditional unitary vision of infrastructures is the explicit recognition of the differing constitution of information objects within the diverse communities of practice that share a given infrastructure” (1999: 314). While ‘scaling up’ from objects to infrastructure (another type of object, in our estimation) grants perspective on the systemic operations of power, the plasticity and translatability of a boundary infrastructure between communities still requires the management of “divergent viewpoints” by way of “accommodations, work-arounds, and in some sense, a higher- level of artful integration” (Bowker and Star 1999: 292).

To this end, we inquire: just how little overlap, or conversely, just how much difference can a boundary object, conscription device, or boundary infrastructure tolerate before one’s notion of cooperation or collaboration breaks down?

In her 2007 article “Boundary Negotiating Artifacts: Unbinding the Routine of Boundary Objects and Embracing Chaos in Collaborative Work”, Charlotte Lee provides a substantial critique of the community’s adoption and use of boundary objects. In her estimation, the problem lies not in the conception of boundary objects themselves, but rather in the “tendency of researchers to label every artifact [that moves

between communities of practice] a boundary object” because “it forces us to deny what we observe, to ignore the finer points of the boundary object definition, or to awkwardly wrap new theories around the [definition of boundary objects]” (Lee 2007: 314). Lee points out that in their original conception, “ultimately boundary objects was posited as a creature based on established standards” and that “[t]he dependence of boundary objects on the premise of established standards is inherently problematic for theorizing incipient, non-routine, and novel collaborations” (2007: 314). To account for artifacts that exist in “projects that are fairly non-routine and fairly complex”, Lee introduces the term “boundary negotiating artifacts” (2007: 334). What is at stake in her critique of her community’s (over)use of boundary objects is the neglect of work practices that do not appear similar to those that gave rise to boundary objects in the first place. Or worse, perhaps, that the study of “incipient, non-routine, and novel collaborations” will be misconstrued, a risk that puts her community’s knowledge on shaky foundations.

In her conclusion, Lee questions whether the focus on “standardized artifacts and stable organizational contexts” is due to them being “most easily codified into our computational systems” (2007: 336). While this is surely not the only reason, it highlights the role of the observer, the person ultimately responsible for the construction of boundary objects / boundary negotiating artifacts. A description of a boundary object or a boundary negotiating artifact is an expression of the frame of reference from which the observer views the world, an expression that is then performed by the reader in the context of the discourse that constitutes the practice of boundary object production.

In the framing of boundary objects, boundary negotiating artifacts, and boundary infrastructures as a means for cooperation and reconciliation—in service of a shared

goal or greater good—the non-neutrality of the boundary as common territory must be taken into account. Designating a border territory or ‘common ground’ for passage and translation between communities requires the drawing of a boundary around this shared space that may not be symmetrical in its inclusivity and reflectivity of interests. When cooperation, reconciliation and collaboration are promoted under the guise of accessibility and diversity, it is important to shed light on colonial and capitalist imperatives to standardize methods and maximize productivity through the self-regulatory and disciplinary effects of power.

While the concept of boundary objects (and its variants) tolerates some degree of difference, it cannot accommodate irreconcilable difference in which there is no reflection of viewpoints between communities. By requiring mirrored interests as the basis for plasticity and translatability—and therefore visibility—the framework of boundary objects positions difference in opposition to similarity, and dissent against consensus.

In time with the person whose heart pulses in your hands, gradually begin to accelerate the pace of your breathing, fully emptying and filling your lungs with each breath. In through your nose, out through your mouth. As you continue to speed up, taking in much more oxygen than your body needs, you may find that the air feels cold in your nose, in your throat, in your chest. Continue faster still. Your fingers may begin to tighten and curl, locking on to the heart. This is normal, it will pass. Faster still.

Feel the heart in your hands beat faster and more regularly as both of you continue to accelerate.

Inhale, exhale, inhale, exhale, inhale.

Interlude: A failed attempt at reflexivity

Here's the thing. Boundary objects are frightening for us because they represent what we perceive to be a practice of colonizing knowledge by recharacterizing it in order to serve the needs of a different community. What we have to account for now is the way in which we performed exactly the same act in order to make our point about it.

Our intent as authors, if such a thing can be trusted, is not to interact with you, the reader, through the transmission and translation of ideas towards shared understanding. We simply do not believe that such authority exists. And yet, our authorial attempts to reflexively account for our role in this discourse are not sufficient to reveal our own sense of intentionality, for in reflexively reflecting ourselves back to ourselves, we cannot but see our own vision of ourselves. The problem is that a reflexive accounting of ourselves as authors in the story we are trying to tell never really brings new information to that story, it simply tells a different story, one that includes us, an accounting for which we must account, reflexively, on and on.

What we must do is bring into question the intra-actively enacted boundaries of ourselves as selves with the authorial capacity to produce an object such as this text, or a shared goal such as this: as authors we seek to articulate approaches to design, in and between multiple communities of practice, that not only tolerate difference, but rather, that require critical difference between practices in order to thrive. Our use of the term critical here and elsewhere is an amalgam of its definitions and stands in for the assertion that the noun it describes matters in a given context. It is not enough to speak of difference, but rather, difference that has crossed an inflection point, difference that

has been brought to a point of critical mass, difference that is essential to a context and that must be cared for in order to prevent it from becoming flattened.

In caring for the critical differences that emerge in our designing of interaction as composer-choreographer, we desire strategies that are not based on critique, for as Barad reminds us:

Critique is all too often not a deconstructive practice, that is, a practice of reading for the constitutive exclusions of those ideas we can not do without, but a destructive practice meant to dismiss, to turn aside, to put someone or something down—another scholar, another feminist, a discipline, an approach, et cetera. (Barad 2012: web)

Our critique in the preceding sections is not a critique of the concept of boundary objects, rather it is a critique of the act of constructing boundary objects. Such an act involves the construction of a community, a practice, and a discourse through the making of their boundaries, and what we have tried to show is that the making of those boundaries is the expression of value systems. The problem is that in order to express our critique of these kinds of acts, we first had to construct a community, a practice, and a discourse in which these acts were performed. It's not enough to say that we did this—to admit our culpability—nor is it enough to point out that the act of critique is an act of making communities that can be critiqued. When communities are made, they are always in relation to the things they are not, including the continual acts of their making, and our goal here is to foreground, so that we may better care for, the relationships that ultimately form these communities.

In search of approaches to designing interaction that bring awareness to the value systems involved in the local production of 'interaction' and 'things that interact', we appropriate Barad's appropriation of 'diffraction' (from quantum physics into agential

realism), as a method to examine patterns of difference that make a difference between communities of research.

Hold your breath.

Diffraction: Critical difference and responsibility in collaboration

Designing interaction involves the mapping of perceived difference between ‘objects of interaction’ (e.g. bodies, gestures, physiological processes, media, etc.), within the frame of reference of the designers. What constitutes ‘difference that matters’ within this locally derived system of interaction depends on the vision of the designers, which necessarily excludes types of difference that are invisible to them. Shifting focus from the reflective tactics of interaction design towards the diffractive performance of intra-action does not necessarily produce greater visibility of difference itself, for difference’s sake. As stressed earlier, Haraway makes the important distinction that: “a diffraction pattern does not map where differences appear, but rather maps where the *effects* of difference appear” (1997: 300, orig. italics). Mapping the effects of differences does not presume that these differences emerged from a unitary source. This is important, because it subverts the assumption that difference can only come to matter in opposition to originary sameness. In this regard, Barad argues that:

If diffraction is to serve as an important metaphor for differences that matter, it is crucial that we pay attention to the kinds of differences that different understandings of diffraction evoke, so as to not conflate questions of accountability to differences that matter with postmodern celebrations of difference for difference’s sake. (Barad 2007: 214)

In Barad's use of the term, 'diffraction' stands in for at least three things: a theoretical description of the behaviour of light and matter as both waves and particles; an ethnography of the development of quantum mechanics in response to a phenomenon that defied explanation in terms of classical physics; and a philosophical proposition that subject and object are not separate or separable. We are inspired by what we read in Barad's development of diffraction as a metaphor, but we must also acknowledge that we do not have the same relationship to science and philosophy that she does. Our background as choreographer-composer in no way precludes us from engaging in scientific and philosophical discourse, but we do have a different frame of reference and we are aware that the boundaries of diffraction, or rather, 'what-we-mean-by-diffraction', are differently haunted for us.

As an approach to intra-active design, what the metaphor of diffraction offers, especially to those involved in cross-disciplinary collaboration, is the proposition that it is possible to work together—responsibly—not only based on a mutual goal or common ground that reflects an overlap in viewpoints, but rather, through an investigation of how and why differences have come to matter for and between individuals, disciplines, and cultures over time. Approaching collaborative work through diffraction requires awareness of the ongoing production of difference, not only quantitatively, but aesthetically and ethically, as it transforms with and through the entangled agencies of participants.

Resist the urge to release. You may feel your chest move involuntarily. This is your diaphragm spasming, trying to pull air into your lungs. Try to relax, and it will pass. Keep holding.

Critical appropriation: Innovation-by-destabilization

Whereas appropriation may be associated with the reflective tactics of interaction—displacing ‘things’ from one context to another without investigating how and why differences emerge—critical appropriation is necessarily diffractive: shifts in ecology and epistemology are positioned as objects of interaction in relation to appropriated materials. Building from our articulations of critical appropriation in the previous sections and chapters, we revisit and elaborate on it here as a provocation to continue to understand things that become objects (people, bodies, movements, gestures, concepts, disciplines, cultures, communities, infrastructures, boundaries, etc.) as inherently multiple, and to bring attention to their ontologies outside of their current subjectivity. This is not a matter of bending the ontologies of objects to fit them inside an ethico-aesthetic frame that is accessible to all parties in a project; rather, critical appropriation is entangled with “a politics and ethics of singularity, breaking with consensus” towards collective subjectivation (Guattari 1995: 117).

In our collaborative practice as a choreographer-composer we place emphasis on the appropriation of biosensors in creation and performance as a means to intervene in the invisible boundaries of our own ethico-aesthetic frame(s) of reference. Our ongoing appropriation of ECG devices, the WiFi technology used to transmit their signals, and the hardware and software used to amplify, process, and transduce those signals so that they may be heard and felt, involves a sustained act of care for discourse surrounding their ontology, epistemology, ethics, and aesthetics. In our re/contextualization of ECG technologies, questions about what an ECG is and how it works are inseparable from questions about what the heart is and why we might want to measure it. Questions about how to relate to a sonified ECG signal in a musical context are inseparable from

questions about how we conceive of musical time, and other temporalities. Practical questions concerned with how to properly wear an ECG and the effects of movement on the signal are inseparable from questions of physiological control, the relationship of space to time in dance, and the ways in which space and time are constructed. The goal for us is to gain insight into our practices as they are disrupted at the point of their intersection with an object of incommensurate difference.

As discussed Chapter 5, ‘noise’ is present in all acts of measurement, but here, perhaps, ‘noise’ can offer opportunities to explore what Guattari might call the “mutant coordinates” of a discipline (1995: 106). The pill that we are offering here is a hard one to swallow: we are suggesting that ‘noise’, the very thing that obfuscates the ‘thing’ we are interested in, should be considered as an opportunity to question the foundations of our interest in that particular ‘thing’; that the ‘noise’ that prevents us from recognizing a particular ‘thing’ as an object of interest for interaction (be it a physiological process, a gesture, or a body) might be an indication that our notions of the constitutive boundaries of this ‘thing’, are, in fact, *noisy*.

By paying attention to the noise of our own perception, we become implicated as subjects in the perceptual process. Likewise, by paying attention to the noise produced by the hardware and software, its designers and users, and the intra-active context of interaction, the exclusion of data from a signal becomes evident. Importantly, there is no un-noisy or un-mediated signal, nor is there an un-noisy or un-mediated perception of this noisy signal. Noise is always present, and in cases of appropriation of technologies, interrogating so-called noise can point towards the operation of ethics within and between collaborators and disciplines.

What is at stake here is the construction of a discipline that no longer recognizes that there are conceptions of gestures, bodies, processes, or concepts, outside of its frame. Once we as a community have decided, implicitly or explicitly, what, for example, a gesture is, we can stop looking for gestures that fall outside of that spatio-temporal frame. The reorientation of the concept of gesture from descriptive to prescriptive brings with it an ethical weight that can stagnate a discipline through the subjugation of aesthetic exploration. That bears repeating: the moment that we make the transition from using the concept of gesture to describe aspects of a mover's movement, to prescribing that movement as a gesture, we have entered into ethical territory that begins to restrict aesthetic choice. This process of restriction is inescapable; our goal here is not to advocate for its dissolution, but rather for a continual process of disruption of ethical restrictions through critical appropriation, collaboration, and aesthetic exploration. Through the intersection of divergent value systems in disciplinary crossings, there is potential for disruption of the calcified conventions of each discipline—by all that haunts them—and therefore a reconfiguration of what is being included and excluded from their respective territories.

As discussed earlier, Guattari likens this type of destabilization to mutation and sees the reframing of disciplinary structures such as psychoanalysis in terms of ethico-aesthetics, rather than simply ethics, as key to resisting stagnation and homogenization.

If we turn for a moment to a discipline like psychoanalysis, which claimed to affirm itself as scientific, it is increasingly clear that it has everything to gain from putting itself under the ægis of this new type of aesthetic processual paradigm. Only in this way can it reacquire the creativity of its wild years at the turn of the century. (Guattari 1995: 106)

In the field of psychoanalysis, this has deep implications that require no less than the redefinition of the body itself.

Let us take as a final example an open redefinition of the body, so necessary for the promotion of therapeutic assemblages of psychosis: the body conceived as intersection of partial autopoietic components, with multiple and changing configurations, working collectively as well as individually; all “the bodies”—the specular body, the fantasmatic body, the neurological corporeal schema, the biological and organic soma, the immune self, the personological identity within familial and environmental eco-systems, collective faciality, refrains (mythical, religious, ideological...). (Guattari 1995: 117-118)

This passage is remarkable in its articulation of an aspect of psychotherapy, a predefined conception of the body and its binary relationship to the brain, that for many practitioners has been rendered invisible by the boundaries of their disciplinary training. Further, it points to the difficulty of the type of work we propose in this text, which is to say, we are advocating for engagements with technology that are harder, not easier, slower, not faster, and which not only defy measurement and evaluation, but call into question the nature of their role.

Our formulation of critical appropriation thus far has been with respect to the use of technology for purposes other than those for which it was designed. Critical appropriation, however, is a general, diffractive practice intended to bring awareness to, and care for, the multiplicity of an object and to prevent its collapse down to something perceived as singular by the practitioners operating inside the structure of an emerging discipline. We appropriate technologies critically as an intervention intended to destabilize the boundaries of our practice, but it is normal for new practices to emerge out of those interventions. As the boundaries of practices are enacted, they become technologies in the world, belonging to others than ourselves, until ultimately that which we engendered, we now appropriate, critically.

Critical appropriation is a destabilizing practice—a process of intervening in moments of relative comfort in order to interrogate aspects of practice that have stabilized and receded into the shadows. From the shadows, these elements continue to calcify into increasingly solid boundaries making voices that come from outside their borders increasingly less intelligible. These boundaries form the ethics of a discipline—they separate those actions that cannot be done from those that must. They produce language that renders utterances unintelligible and construct the machinery that allows actions to be seen as transgressions. To repeat more generally, what is at stake here is the construction of disciplines that can no longer recognize forms of knowledge and know-how that operate outside of, yet continually haunt their boundaries.

Release the air in your lungs as you gently release the heart in your hands. Bring awareness to the rising and falling of your pulse as you breathe deeply and slowly, in through the nose, out through the mouth. Find a position that's comfortable as you recover your breath.

Postlude: Apologia

Wherever you are, imagine you are us, and there are three people sharing the space with you: Karen Barad, Michel Foucault, and Félix Guattari. They are seated or standing, silent, relaxed, simply listening and observing. You, choreographer-composer, in making a point to yourself, composer-choreographer, reach for a text you did not write, wielding it as a weapon of debate, subject to the gaze of the person who wrote it and their peers.

Appropriation is always violent, and we have engaged in it throughout this text; for that we apologize, especially to those from whom we have taken and mis-re-presented.

Appropriation is not ok and cannot be made ok by acknowledging or apologizing; the only thing we can do is act responsibly inside of the context of our own making. The words on these pages are ours, even those we attribute to other authors—and now they are yours.

Chapter 8: Conclusion

I want to begin by re-turning – not by returning as in reflecting on or going back to a past that was, but re-turning as in turning it over and over again – iteratively intra-acting, re-diffracting, diffracting anew, in the making of new temporalities (spacetime-matterings), new diffraction patterns. (Barad 2014: 168)

Re/iterations

My proposal is this: the critical appropriation of technologies (tools, techniques, theories, taxonomies) beyond familiar use, has potential to inspire mutual destabilization—and innovation—with regard to that which constitutes knowledge within and between disciplinary cultures over time.

My question is this: how can I devise contexts in which ‘diffractive’ encounters emerge between bodies-of-knowledge, illuminating critical differences in conceptions and representations of the thing-we-call-the-body—as these differences come to matter for different people in different ways?

My concern is this: the transit of technologies between differentiated-yet-entangled research cultures enacts a collision of implicit value systems—values which, if left unexamined, may subordinate the concerns of one community in service of another.

My hunch is this: as artists de- and re-contextualize biosensors as well as biosensing techniques such as sonification and biofeedback, they, or rather ‘we’, have an opportunity to interrogate the entangled value systems in movements such as phenomenology, structuralism, materialism, constructivism, positivism, and new materialism, that not only enable but constrain the intelligibility of different ‘things’—bodies, biology, gestures, movements—within our frames of reference.

My approach is this: I thread disparate knowledges throughout these pages, making no attempt to reconcile differences in conceptions and representations of bodies; on the contrary, I seek to foreground the destabilizing yet generative potential of continual processes of differentiation between bodies-of-knowledge—which remain always-already entangled with other bodies-of-knowledge.

My desire is this: to probe cross-disciplinary discourse on the ways in which different knowledges *about, in, and as* bodies and movements come to matter differently in the world.

And also this: to cultivate cross-, inter-, and trans-disciplinary collaborations that not only accommodate difference, but which require the effects produced by critical difference to thrive.

Re/framings

On this thesis, beyond itself

The basic premise of this thesis is that no ‘thing’ is a thing in-itself. In the body of my thesis, I applied this notion to the thing-we-call-the-body, the thing-we-call-the-heart, and the thing-we-call-interaction. By way of conclusion, I now ‘re-turn’ this notion—of ontological multiplicity and relationality—applying it in turn to the thing-I-call-my-thesis.

My thesis is not a ‘thing’ in-itself. My thesis, by which I mean this document and its performance, is an entangled-differentiation; one thesis among theses. This thesis (my thesis), as with any creation, involves the continual circulation of “*that which is in [this thesis]* and *that in which [this thesis] is*, or that which it comprehends and that which

comprehends it”—as a contribution to knowledge amidst bodies-of-knowledge in academia (Garcia 2014: 11, orig. italics). The bodies-of-knowledge that circulate *in* and *as* this thesis are bound by the constitutive exclusions that form my own knowledge, and my own body, as a body-of-knowledge. As Garcia stresses:

As for the limits of my knowledge, or its conditions, it always seems that to know the limits of what I do know comes back to knowing the limits of what I do not know. Now, to know the limits of something is to know its unity, contour, and determination. Not only can I make something of what escapes my knowledge, but I cannot even avoid making something of it on the outside. (Garcia 2014: 28)

In “making something” of that which “escapes my knowledge” (and therefore my thesis), I am admitting responsibility for the effects produced by my (and its) constitutive exclusions (Garcia 2014: 28). This does not mean making a list of all the things I have excluded from discussion; to the contrary, this list would inadvertently reinforce the exclusion of all that lies beyond my frame of reference, and therefore my list. In making a point-form list of all that escapes the body-of-knowledge that is my thesis, I would surely miss the point. And, as Barad states, “[t]he point is this: one can’t simply bracket (or ignore) certain issues without taking responsibility and being accountable for the constitutive effects of these exclusions” (2003: 58). But how do we practice ‘responsibility’ towards exclusions that are invisible to us? What of exclusions which are unintentional, yet necessary, in that they are the very condition for the intelligibility of other things, things that come to matter in our frame of reference? Rather than tying responsibility to *a priori* knowledge of things in-themselves, Barad argues that:

[r]esponsibility, then, is a matter of the ability to respond. Listening for the response of the other and an obligation to be responsive to the other, who is not entirely separate from what we call the self. This way of thinking ontology,

epistemology, and ethics together makes for a world that is always already an ethical matter. (Barad 2012: web)

In the always-already ethical becoming of the world, aesthetic experimentation is a critical means to probe the “mutant coordinates” of bodies-of-knowledge, hinting at the constitutive exclusions through which different ways of seeing and saying become intelligible (Guattari 1995: 106). Encounters between artistic and medical performance, inspired via the appropriation of technologies (tools, techniques, theories, taxonomies), present an opportunity to investigate critical differences in conceptions and representations of bodies without flattening or collapsing the specificity and rigour of disciplinary motives, methods, and modes of articulation.

On the multiplication of the parts of this thesis

Like my thesis *itself*, the ‘parts’ of my thesis (its chapters and sub-sections) are not (only) significant in and of themselves. No part of this thesis can signify fully—that is, in its multiplicity and potential multiplications—when dissected from the body of this thesis. No one part in this thesis is positioned here solely, or even primarily, to examine that which it purports to talk *about*. There is little reason to read a text about medical uses of biosensors written by a choreographer, supported by secondary sources; by all means, read a text by a medical professional for that purpose! I am an artist—I certainly cannot be trusted to tell you anything *certain* about the body, nor is that my goal. In and between the bodies-of-knowledge I traverse in this thesis, from antiquity to present day, my interest is not to critique, substantiate, or elaborate any particular disciplinary conception of the thing-we-call-the-body *itself*. The act (my act) of transplanting narratives about the body from far and wide into the body of this thesis is a means to stir

up ontological uncertainty—by way of diffractive encounters between bodies-of-knowledge.

The broad scope of my thesis, with circulation between science, art, and philosophy, and over the course of centuries, is necessary as means to produce the conditions in which diffractive encounters (may) emerge between bodies-of-knowledge. Diffractive encounters between bodies-of-knowledge are an opportunity for mutual destabilization and innovation, such that the ontological, epistemological, ethical, and aesthetic assumptions that govern notions of ‘truth’ and ‘mastery’ in each discipline come into question. I am aware that as I venture into various domains, beyond dance and choreography, there is risk that I may offend, or come across as naive. I proceed nonetheless—with care for perceived transgression—because the rigour of this thesis is not situated in the realm of any singular discipline. Rather, the rigour of this thesis arises in its navigation of entanglements between different articulations of knowledge about bodies, without creating the illusion of disentanglement between these bodies-of-knowledge for ease of examination. The bodies-of-knowledge that fold into one another throughout these pages—dance, somatics, music, choreography, composition, HCI, interaction design, STS, medicine, and feminist, process, and new materialist philosophies—are not positioned here to disseminate their disciplinary knowledge in its own right. Rather, the circling and circulation within and between different domains throughout this thesis, dilating from the viewpoint of a single artist to schools of thought, and spanning millennia, is a means to examine the effects of their continual differentiation, yet entanglement.

On critical appropriation as a means to incite intra-action

In this thesis I have proposed the notion of ‘critical appropriation’ as a means to incite diffractive encounters between bodies-of-knowledge. Given the movement of technologies across disciplines—for example, the movement of biosensors from medicine to art, with or without explicit collaboration—what critical appropriation offers is “the provocation that things only become things through exclusion, that what is excluded forms the basis for other onto-epistemologies, and that we bear responsibility for that which we exclude” (MacCallum and Naccarato 2019: 427). In a similar vein, the notion of ‘diffraction’ (taken from Barad into the context of my collaborative work), hints at ways to work together “responsibly—not only based on a mutual goal or common ground that reflects an overlap in viewpoints, but rather, through an investigation of how and why differences have come to matter within and between individuals, disciplines, and cultures over time” (MacCallum and Naccarato 2019: 427). Approaching collaborative work diffractively requires awareness of the ongoing production of difference, not only quantitatively, but aesthetically and ethically, as it transforms with and through the entangled agencies of collaborators—including between author and audience.

This thesis advocates for diffractive approaches to collaboration in practice-as-research by crafting conditions in which diffraction may unfold, thus demonstrating its own distributed contributions across domains. Admittedly, the distributed character of diffractive contributions can make their value difficult to pinpoint, because their point is necessarily plural, hybrid, entangled—a moving target amongst bodies-of-knowledge.

The point of a diffractive approach, for example in this thesis or in other iterations of *III*, is not necessarily immediate ‘impact’, as in impact on a particular person, practice,

theory, discipline, or community. Rather, the point of a diffractive approach to collaboration is, in part, its pointlessness, in the sense that this pointlessness allows it to resonate laterally, transversally, between ‘things’, including people, as they become (and un-become) entangled-differentiations. As Barad reminds us:

To be entangled is not simply to be intertwined with another, as in the joining of separate entities, but to lack an independent, self-contained existence. Existence is not an individual affair. Individuals do not preexist their interactions; rather, individuals emerge through and as part of their entangled intra-relating. Which is not to say that emergence happens once and for all, as an event or as a process that takes place according to some external measure of space and of time, but rather that time and space, like matter and meaning, come into existence, are iteratively reconfigured through each intra-action, thereby making it impossible to differentiate in any absolute sense between creation and renewal, beginning and returning, continuity and discontinuity, here and there, past and future.
(Barad 2003: ix)

Re-configuring the notion of ‘interaction’ between pre-constituted ‘things’ (e.g. bodies, gestures, practices, concepts, theories, collaborators, or communities), the entangled notions of diffraction, intra-action, and critical appropriation involve a “continual process of explicitly engaging in the local production of subjectivity”, and position those responsible for the design of relationality between things, for example ‘us’ as choreographer-composer, within the intra-active context of interaction (MacCallum and Naccarato 2019: 412).

On my body-of-knowledge as an entangled-differentiation

In writing this thesis as ‘I’—not ‘we’—my voice becomes identifiable to me as ‘mine’ through differentiation-yet-entanglement with its ‘implicit others’—collaborators, mentors, colleagues, friends. For me this thesis, as part of *III*, is in processes of continual, entangled-differentiation with other parts of my collaboration in *III*, including performances, installations, workshops, artist talks, and publications. The ways in which

I have shaped this thesis as a potential site of diffraction between people, practices, and philosophies, is entangled with the ways in which I craft ‘works’ in *III* more generally. In *III* we make work by devising scenarios in which the intra-action of intra-actively defined ‘things’ (practice and theory, performers and public, authors and readers, choreographer and composer) invites a folding and re-folding of knowledges upon knowledges—without compacting or closing the processes of material-discursive becoming between said things. In *III* our emphasis on relationality and proliferation beyond dichotomous designations—body/mind, human/inhuman, animate/inanimate, material/discursive, biological/cultural—is not realized by simply grouping more than two pre-constituted things together. Rather, the three-ness in *III*—its excessiveness beyond I or II—emerges from our shaping of contexts in which the multiplication of the effects produced by continual differentiation between parts and participants means the ‘thing’ (any-thing) we create is always-already more than the sum of its parts.

The various ‘parts’ of this thesis (its chapters, its pages, its words) become significant through their continual “cutting-together apart” with all other conceivable parts in the shared domain of this document (Barad 2014: 176). For me, and my collaborators, this thesis *itself*, as part of *III*, can come to matter in our project only through its iterative differentiation, yet indivisibility, from all other iterations of the thing-we-call-*III*—past, present, and possible. In the context of my practice-as-research PhD, the relation of this thesis with other aspects of my collaboration in *III* requires the delineation of boundaries between that which is and that which is not my doctoral contribution, and that which is and that which is not authored by ‘me’ personally. In enacting these boundaries, all that which I exclude from representation within the frame of my thesis—

practically and theoretically, personally and professionally—comes to bound my thesis as its constitutive outside.

On exteriorities-within (in) this thesis

The production of ‘knowledge’ in any domain—art, science, and philosophy alike—is the devising of a context, of a world, in which this knowledge becomes intelligible—in which this knowledge has the potential to come to matter for particular people, in particular places and periods of time. *III* is about enacting such worlds. These ‘new worlds’ *in* and *as* our frames of reference, relate to what Foucault describes as the *a priori*, i.e. that which:

in a given period, delimits in the totality of experience a field of knowledge, defines the mode of being of the objects that appear in that field, provides man’s everyday perceptions with theoretical powers, and defines the conditions in which he can sustain a discourse about things that is recognized to be true.
(Foucault 1982a: 117)

Thinking about conceptual shifts over the course of centuries, philosopher Alfred North Whitehead cautions, in a similar vein to Foucault, that direct negation or critique of entrenched value systems and knowledges is ineffectual because it is grounded in that which one already knows, and that which others assume to already know. He advises that:

When you are criticizing the philosophy of an epoch, do not chiefly direct your attention to those intellectual positions which its exponents feel it necessary explicitly to defend. There will be some fundamental assumptions which adherents of all the variant systems within the epoch unconsciously presuppose. Such assumptions appear so obvious that people do not know what they are assuming because no other way of putting things has ever occurred to them. With these assumptions a certain limited number of types of philosophical systems are possible, and this group of systems constitutes the philosophy of the epoch. (Whitehead, cited in Gillet 2016: 1)

While glacial shifts of value systems may not be perceptible within our individual frame of reference, and are certainly not under our individual control, the distributed effects of power across epochs means that we are always-already implicated in the continual, intra-active re/configuration of aesthetic and ethico-onto-epistemological boundaries. Through our entangled-differentiation as subjects, our individual frame of reference is co-constituted with and within these boundaries.

The building of these new worlds—*in* and *as* our frames of reference—is our art and is our research in *III*. In *III* we appropriate ‘technologies’ (objects, concepts, practices, theories)—critically—as a means to probe the effects of iterative processes of entangled-differentiation through which transient frames of reference are enacted. Our practice of critical appropriation remains ‘critical’ in as much as it continues to care for the effects produced by differentiation between frames, and between worlds, without attempting to synthesize or reconcile these differences in service of shared understanding or collaboration. Critical appropriation is a means to cultivate and care for ‘critical difference’, which is, once again: “difference that has crossed an inflection point, difference that has been brought to a point of critical mass, difference that is essential to a context and that must be cared for in order to prevent it from becoming flattened” (MacCallum and Naccarato 2019: 424). In the world of *III*, and in the worlds we create in *III*, the practice of critical appropriation incites spillage between bodies-of-knowledge—bodies which are not separate in an absolute sense, but which are bound (and therefore haunted) by different constitutive exclusions. This spillage between bodies-of-knowledge (disciplinary, ideological, cultural) may “illuminat[e] the indefinite nature of boundaries—displaying shadows in ‘light’ regions and bright spots in ‘dark’ regions—[...] a relation of ‘exteriority within’ [which] is not a static

relationality but a doing—the enactment of boundaries—that always entails constitutive exclusions and therefore requisite questions of accountability” (Barad 2003: 135). The illumination of these “exteriorities-within”, by way of critical appropriation, is a means to invite generative destabilization of the implicit value systems that sustain ‘things’ themselves, including the thing-we-call-research within and between always-already entangled disciplinary worlds.

On the intelligibility of my practice-as-research

The resonance of this thesis as a contribution to knowledge in the context of practice-as-research requires the crafting of a frame in which its body-of-knowledge comes to matter *intra-actively*. The focus in this thesis on wide-ranging conceptions and representations of bodies and movement has served to illuminate diffractive encounters between entangled bodies-of-knowledge (artistic, scientific, philosophical) over the course of centuries. This thesis is not only explicative, but performative, as an actualization of diffractive methodologies in practice-as-research. The identifiable outcomes of my doctoral practice-as-research include:

- The notion of *critical appropriation*, with regard to technologies (tools, techniques, taxonomies, theories), as a means for generative destabilisation and innovation within and between communities of research;
- The practice of ‘Relational Listening’, and the performance of *III: Circulation*, as entangled realizations of critical appropriation and intra-active design in my collaborative practice-as-research with composer John MacCallum;
- This thesis as a further performance of critical appropriation and intra-active design, setting conditions for diffractive encounters between bodies-of-knowledge which not only accommodate, but require the effects of critical difference to ‘make sense’.

Re/turnings

I.

This thesis is not *on* or *about* any-one-thing, nor every-one-thing. This thesis circles and circulates, moving transversally between entangled-yet-differentiated ‘things’—between practice and theory, between art, philosophy, and medicine, between self and other and others—without ever getting to an *original* point. Without pointing.

II.

This thesis cannot be any-one-thing, nor can it be every-one-thing. This thesis is a ‘thing’, but not a thing in-itself. This thesis is a thing among things; it is a thesis among theses, identifiable as such through its sustained differentiation-yet-entanglement with the thing-we-call-a-thesis within the thing-we-call-academia.

III.

This thesis does not represent any ‘thing’ beyond itself, yet it cannot *become* in-itself. This thesis, akin to other theses, requires “a circulation of being that systematically distinguishes two senses [*sens*] of things: *that which is in a thing* and *that in which a thing is*, or that which it comprehends and that which comprehends it” (Garcia 2014: 11, orig. italics). This thesis is the difference between that which is in this thesis and that in which this thesis is, or that which it contributes, and that which contributes to it—as a body-of-knowledge.

IV.

Although this thesis is a body-of-knowledge, its body is not self-contained, nor is it the sum of its parts. Multiple bodies-of-knowledge traverse each and every other body-of-knowledge, emerging as bodies only through their sustained differentiation, yet

entanglement. Entanglements are not produced by dissecting or transplanting pre-defined ‘things’ from one site to another. Entangled-differentiations involve the multiplication of the effects produced by different “differences-in-the-(re)making” (Barad 2014: 175). Entangled-differentiations require diffraction and intra-action. Bodies-of-knowledge are entangled-differentiations.

V.

Our bodies, as bodies-of-knowledge, are not self-contained, nor the sum of their parts. That which I produce produces me, just as that which produces me is produced by me. ‘I’ circulate between that which is in ‘me’ and that in which ‘I’ am.

VI.

As author I have shaped this thesis as a context in which diffraction may (or may not) emerge between bodies-of-knowledge. The convergence and divergence of bodies-of-knowledge throughout this document is an invitation for encounters in which insights spill through and around one another, creating interference and entanglement—without resolution.

VII.

The body of this thesis is a matter of bodies folding into bodies, folds upon folds, without compacting, without closing, without finitude. This body folds to open, moving always—if imperceptibly. The body of this text, as a body-of-knowledge, is always not-yet. To examine this body-becoming, I must examine its folds, its folding of knowledges, from which and as which knowledges proliferate.

VIII.

That which constitutes this thesis as a body-of-knowledge is entangled with that which I hope this thesis may do—that is, cultivate cross-disciplinary discourse on the ways in which different knowledges *about* and *in* and *as* bodies and movements come to matter differently in the world.

IX.

This thesis is not an exegesis, positioned as derivative or explicative of my other practices (choreography, performance, video, interaction design, etc.). This thesis is my practice—as research. This thesis is my practice-as-research in *III*.

X.

In this thesis, as in other aspects of *III*, I gather disparate perspectives—from choreography to composition to medicine to interaction design to philosophy—teasing out knowledges within and between entangled bodies-of-knowledge by way of differentiation and diffraction. What I offer you here are entangled threads from the many practices (writing, moving, reading, thinking, listening, touching, fucking, etc.) through which I make sense *in* and *of* the world.

XI.

Bodies-of-knowledge are in relation because they are in processes of continual entangled-differentiation. In bringing awareness to the ethical weight of exclusion by which the boundaries of knowledge in a given practice of research—including practice-as-research—are continually enacted, the operation of the implicit value systems that police its borders, and border crossings (from practice to theory, from art to research), may themselves be interrogated from within and as part of this research practice itself.

XII.

In trying to locate the ‘heart’ of my practice-as-research—its pump, its pulse, its propulsion between stage and page—I find my logic circling, and circulating, unable to perform vivisection without stilling, without killing. When I cut into the live flesh of my practice, when I attempt to transplant its heart into foreign bodies, I make a fundamental shift to its ontology. When I cut into the flesh of my writing-moving-making-thinking, it is the tip of my own scalpel that becomes the point—a point of transgression, a point of contamination, a point of penetration between bodies-of-knowledge.

XIII.

This thesis has no heart, no centre, no mechanism we may dissect in order to understand what makes it tick. To ‘get’ this thesis, we must enter into circulation with it, moving transversally between differentiated-yet-entangled ‘things’—between practice and theory, between art, philosophy, and medicine, between self and other and others—without ever reaching an ultimate point.

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Appendices

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From representation to relationality: Bodies, biosensors and mediated environments

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ABSTRACT

In this article we propose a biorelational framework for performance with biosensors, in which interactions are not based on causality, control, and representation, but rather, manifest through shared awareness and agency across multiple, fluid assemblies of self, other and environment. The transdisciplinary scope of this study traces trajectories from the performing and somatic arts into philosophy, biomedicine, cognitive science and human-computer interaction. A brief survey of common approaches to interaction design with biosensors will contextualize discussion of our current practice-based research and creation project, 'Choreography and Composition of Internal Time'. In this project, we are examining temporal relationships between physiological processes, such as heart rate and breath, with rhythms in movement, music and mediated environments.

KEYWORDS

biosensors
biofeedback
biorelational
entrainment
embodied agency
interactive
performance

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Appendix B

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Critical Appropriations of Biosensors in Artistic Practice

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ABSTRACT

In this article we discuss the ethical and aesthetic implications of the appropriation of biomedical sensors in artistic practice. The concept of cross-disciplinary appropriation is elaborated with reference to Guattari's ethico-aesthetic paradigms, and Barad's metaphor of diffraction as methodology. In reviewing existing artistic projects with biosensors, we consider ways in which the recontextualization of technologies, and likewise techniques, can both propagate and violate disciplinary expectations and approaches. We propose that by way of critical appropriations of biosensors in artistic practice—that is to say, de- and re-contextualizations of biosensors that acknowledge the shift of ecology and epistemology—artists have a vital role to play in troubling reductive representations of bodies, and furthermore, destabilizing the ethico-aesthetic boundaries of differently constituted disciplines.

CCS CONCEPTS

•**Human-centered computing** → *Interaction design theory, concepts and paradigms; Collaborative and social computing theory, concepts and paradigms;*

KEYWORDS

Critical appropriation, ethico-aesthetics, diffraction, biosensors, interaction design, contemporary dance, contemporary music

ACM Reference format:

Teoma J. Naccarato and John MacCallum. 2017. Critical Appropriations of Biosensors in Artistic Practice. In *Proceedings of MOCO '17, London, United Kingdom, June 28-30, 2017*, 7 pages.
DOI: 10.1145/3077981.3078053

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MOCO '17, London, United Kingdom

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978-1-4503-5209-3/17/06...\$15.00
DOI: 10.1145/3077981.3078053

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Appendix C

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ARTISTIC PRACTICE-AS-RESEARCH: A GENEALOGICAL ACCOUNT

TEOMA NACCARATO¹

Keywords

practice-as-research
practice-based PhD
genealogy
discourse
ethico-onto-epistemology

Abstract

In this chapter I address the processes of exclusion by which the discourse of practice-as-research is constituted and sustained. I ask: what is or is not practice; what is or is not practice-as-research; and why or why not choose to call practice research? By interrogating the boundaries of practice-as-research – within which I practice research – I probe the value systems through which entangled knowledges become differentiated.

Introduction

Answer me this: Why would artistic practice *not* be considered research? Further, why would practice-as-research *not* belong in a university? As an artist in academia, I share these questions with sceptics and advocates of practice-as-research alike to interrogate the implicit values that circulate as doubt about what practice-as-research is, where it belongs, and why and for whom it *might* matter.

A word of caution before we proceed: the request to explain how artistic practice relates to research is a trap. Describing the interaction of practice and research reinforces the assumption that these are independent processes to begin with, which come into contact in ways that can be observed, or even designed. In reflecting on unfamiliar and emergent research practices with the logic of familiar and dominant methodologies, divergent expressions of knowledge remain illegible – or even invisible – within established systems of interpretation and evaluation. What might be considered practice and research ‘become’ together, in context, and are ontologically and epistemologically bound.

Consider this: there is no research without practice, because the doing of research is itself a practice. In research practices, the motives and methods of the researchers are entangled with the knowledges produced. As Karen Barad emphasizes:

We don't obtain knowledge by standing outside the world; we know because we are *of* the world. We are part of the world in its differential becoming. The separation of epistemology from ontology is a reverberation of a metaphysics that assumes an inherent difference between human and nonhuman, subject and object, mind and body, matter and discourse. Onto-epistem-ology – the study of practices of knowing in being – is probably a better way to think about the kind of understandings that we need to come to terms with how specific intra-actions matter.²

As researchers, we are part of research cultures in their differential becoming; this differentiation involves the continual exclusion of voices and knowledges as a means to sustain the boundaries within which contributions to knowledge become significant – or non-signifying. In the

political positioning of practice as a form of research in universities, advocates must account not only for what constitutes knowledge in practice-as-research, but also for what knowledges are excluded – intentionally or not – from this privileged frame. Such accountability entangles onto-epistem-ology with ethics:

[...] what we need is something like an ethico-onto-epistem-ology – an appreciation of the intertwining of ethics, knowing, and being – since each intra-action matters, since the possibilities for what the world may become call out in the pause that precedes each breath before a moment comes into being and the world is remade again, because the becoming of the world is a deeply ethical matter.³

In bringing awareness to the ethical weight of exclusion by which the boundaries of knowledge in a given practice of research – including practice-as-research – are continually enacted, the implicit value systems of its advocates and sceptics (myself included) may be examined.

In the subsequent sections I propose a genealogical account of the discourse of practice-as-research: firstly, I query what it means to have a practice, as the basis from which this practice may be deemed research; secondly, I entangle interpretations of practice and theory, from phenomenology to positivism; thirdly, I interrogate what is *not* considered research within the frame of practice-as-research, as well as how, why, and by whom qualifying practices-as-research are evaluated.

What is (not) practice?

Practices within and between disciplinary boundaries

In order to pursue practice-as-research, it follows that one must pursue a practice. Artistic practice. Somatic practice. Medical practice. Legal practice. Spiritual practice. At times, one may fall out of practice. If an individual stops practicing, or practices less, at what point does their activity no longer qualify as a practice? Does a surgeon who has not performed surgery in one, five, or even ten years still have a medical practice? Does a choreographer who has not created work for an extended period of time still have a choreographic practice? Conversely, if one

begins a new activity, like playing the piano or taking ballet lessons, at what point is this activity elevated to the status of being an artistic practice – this individual's practice as an artist? According to the Wikipedia entry for 'Practice (learning method)': "Practice is the act of rehearsing a behavior over and over, or engaging in an activity again and again, for the purpose of improving or mastering it, as in the phrase 'practice makes perfect'."⁴ This suggests that establishing a practice requires repetition, duration, and mastery – but how much repetition, how much duration, and how much mastery – and according to whom?

According to Malcolm Gladwell: "the magic number for true expertise: ten thousand hours" – with the caveat that training must begin in childhood.⁵ Other researchers argue however that factors such as "general" and "central" intelligence, "working memory capacity," and heredity must also be taken into account in paths to "success."⁶ The quantitative measures of disciplinary expertise espoused by the 'practice makes perfect' camp versus its critics invokes a sticky debate between the role of biological determinism versus cultural constructivism in the 'road to success.'

In what ways, however, are the above narratives of success undermined when practices are understood as *disciplinary*, i.e. self-regulatory systems wherein cause and effect between objectives, behaviours, and outcomes are not predetermined or distinguishable? Michel Foucault describes the disciplinary effects of power as:

[...] a total structure of actions brought to bear upon possible actions; it incites, it induces, it seduces, it makes easier or more difficult; in the extreme, it constrains or forbids absolutely; it is nevertheless always a way of acting upon an acting subject or acting subjects by virtue of their acting or being capable of action. A set of actions upon other actions.⁷

Any judgment of what constitutes either having or falling out of a given disciplinary practice is highly subjective and situated, owing to the disciplinary effects of power operating within and as attitudes-towards-attitudes over time. In the arts, qualifications for practitioners are largely self and peer-defined, with measures that vary within academic and professional circles, as well as geographically. In scientific traditions such

as surgery, psychiatry, or pharmacy, attempts to standardize qualifications are important for public safety, yet still vary across regions and over time.

The implicit and explicit assessment procedures of various practices work to define and maintain the local membership of a practice, i.e. which practitioners can claim to *have* this practice, as well as the external borders of a practice, i.e. how this practice is different than other practices. The mutual constitution of the boundaries within and between practices means that these boundaries are always already in shifting relation, with the threat of disruption and transgression from one another.

The Practice/Theory Trap

Supposing that a person indeed has a practice, attempts to qualify this practice in relation to theory reinforce the assumption that practice and theory emerge as separate processes. Oxford Dictionaries provides multiple definitions of practice as it relates to theory, stating firstly that practice is: “the actual application or use of an idea, belief, or method, as opposed to theories relating to it.”⁸ Simply put: through practice, we apply theory – not produce it. The separation of theory and practice in this explanation has deep roots in Cartesian metaphysics with its hierarchic split of mind over body, immaterial over material, and abstract over concrete. In *Meditations on First Philosophy* (1641), philosopher René Descartes urges scepticism regarding subjective, sensory perceptions derived in human experience, and proposes that through the mind and soul one can attempt to overcome the deceitful nature of mortal matter in search of certainty, truth, and ultimately God.⁹

I will suppose then, that everything I see is spurious. I will believe that my memory tells me lies, and that none of the things that it reports ever happened. I have no senses. Body, shape, extension, movement and place are chimeras. So what remains true?

Perhaps just the one fact that nothing is certain.¹⁰

The doubt regarding experiential knowledge seeded by Descartes is consequential with regards to embodied practices – which all practices are – as *meaningful* modes of research. Whether in somatic or medical practice, physics or philosophy, if phenomenal processes such as vision, memory, body, and movement cannot be trusted, what then is the

relationship of these processes, if any, to constructions of knowledge? In his 'Objections and Replies' to the *Meditations*, Descartes elaborates:

Although there is deception or falsity, it is not to be found in the senses; for the senses are quite passive and report only appearances, which must appear in the way they do owing to their causes. The error or falsity is in the judgement of the mind [...]. Nevertheless, when deception occurs, we must not deny that it exists; the only difficulty is whether it occurs all the time, thus making it impossible for us ever to be sure of the truth of anything which we perceive by the senses.¹¹

The uncertainty expressed by Descartes must be understood contextually in the era during which he lived, i.e. before the rise of Cartesian dualism, certainty, and objectivity, and before Edmund Husserl's phenomenology.¹² Susan R. Bordo proposes that Descartes' practice of first-person intentionality in the *Meditations* "may be understood, loosely, as a 'phenomenology' of Cartesian skepticism,"¹³ taking note of "how unresolute a mode of inquiry they embody: the dizzying vacillations, the constant questioning of the self, the determination, if only temporary, to stay *within* confusion and contradiction, to favor interior movement rather than clarity and resolve."¹⁴ And yet, the "model of knowledge that Descartes bequeathed to modern science [...] is based on clarity, certainty, and detachment."¹⁵ Reframing the *Meditations* as a "'phenomenology' of Cartesian scepticism" brings into question oppositional accounts of Cartesianism versus Phenomenology, as well as the ways in which these ideologies have become associated with practices of objectivity in the *hard* sciences versus subjectivity in the *soft* research of the arts and humanities. Doubtful as it may be, this binary between objective and subjective research is reinforced time and again by adherents of both sides in a reactionary battle to validate the continued membership and support of their chosen disciplinary practice.

Entangled practice: Positivism and Phenomenology

Discussing the radical orientation of both Descartes and Husserl towards ontological uncertainty, Paul S. MacDonald suggests that:

Both Descartes and Husserl envision an overall response to the sceptical challenge as a demand to renovate the principles under which claims to 'scientific' knowledge are made at all. For each thinker this involves demolishing a false picture or model of what a scientific theory of the world would seem to require a mind to be: for Descartes the mind was another 'object,' but of a unique kind; for Husserl, the mind could never be another kind of object encountered in the world. Their radicalization of pregiven structures of scientific knowledge disclosed an entirely new world [...] not simply a new way of looking at an old problem, or new terms for expressing an accepted distinction, but rather an entirely new philosophical discourse in which that problem or that distinction can be articulated.¹⁶

Only through these emergent contexts, i.e. 'new worlds,' could Descartes' and Husserl's discursive conceptions of bodies and minds become salient. Short of deconstructive methods, if and when practices and theories stretch beyond the boundaries of existent discourse, they may remain incomprehensible – or even invisible – as contributions to knowledge within pre-existing cultures of research. As Foucault describes:

This *a priori* is what, in a given period, delimits in the totality of experience a field of knowledge, defines the mode of being of the objects that appear in that field, provides man's everyday perceptions with theoretical powers, and defines the conditions in which he can sustain a discourse about things that is recognized to be true.¹⁷

While contemporary texts may frame practices of research in "modernity," 'the scientific paradigm,' 'the Cartesian model,' [and 'phenomenology'] as discrete, contained, historical entities about which coherent 'closing' narratives can be told,"¹⁸ investigating the effects of such movements across cultures and disciplines over time points to their entanglement, and potential destabilization, within situated conceptions of knowledge. These situated discourses – as practices – must be interrogated not only for the knowledge they produce, but also for the ways in which they constrain the production and distributed activity of other forms of knowledge. In emergent and hybrid processes of discourse – which may involve reading,

writing, discussing, moving, making, or even stillness and silence – it is critical to remember that “[discourse] is not what is said; it is that which constrains and enables what can be said. Discursive practices define what counts as meaningful statements,”¹⁹ and likewise, what constitutes a meaningful contribution to knowledge within a given frame of reference.

In deconstructing the operation of disciplinary power throughout the history of medical, psychiatric, penal, and religious discourse, Foucault argues “contrary to the phenomenologists,” that constitutions of knowledge cannot be accounted for solely “by historicising the subject,” i.e. positioning the researcher as the producer and transmitter of situated knowledge. Rather, the deconstruction of disciplinary power requires a process of:

[...] genealogy, that is, a form of history which can account for the constitution of knowledges, discourses, domains of objects, etc., without having to make reference to a subject which is either transcendental in relation to the field of events or runs in its empty sameness throughout the course of history.²⁰

Taking, for example, Foucault’s genealogy of medical discourse, he notes a transformation starting at the end of the eighteenth century and spanning twenty-five to fifty years, during which the field:

[...] broke not only with the ‘true’ propositions which it had hitherto been possible to formulate but also, more profoundly, with the ways of speaking and seeing, the whole ensemble of practices which served as supports for medical knowledge. These are not simply new discoveries, there is a whole new regime in discourse and forms of knowledge.²¹

In Foucault’s account of knowledge, practices and theories are inextricably entangled through the disciplinary effects of power that regulate the boundaries of disciplinary discourse from within. The disciplining of “ways of speaking and seeing” is not a matter of determinism and prohibition, but rather involves continual processes of discursive constraint, through which particular practices contribute to the salient knowledge of a discipline – thus gaining the status of being a practice, or even, a practice that is research.

What is (not) practice-as-research?

The discourse of PaR

Since the 1960s in the UK and internationally, practitioner-researchers have advocated for the value of alternative methods of knowledge production in an academic context.

Sometimes called the ‘practice turn’ the trend was widespread across many disciplines – from philosophy through science and technology to cultural studies – and characterised by post-binary commitment to activity (rather than structure), process (rather than fixity), action (rather than representation), collectiveness (rather than individualism), reflexivity (rather than self-consciousness), and more.²²

The discourse of PaR is not exclusive to the arts: “Indeed, practice is precisely the thing that artists have in common with other forms of scholarship and research.”²³ Across academic disciplines, what differentiates practices that are research, from those that are not?

In an attempt to reconcile artistic PaR with academic research Robin Nelson outlines three categories of research: personal, professional, and academic, and argues that while all of these types of research “involve investigation, finding things out and drawing conclusions”:

[...] only academic research requires that you must *establish new knowledge* or, to use the slightly softer phrase, afford *substantial new insights* (again the emphases are used to indicate the importance of these phrases). These criteria apply in all disciplines and, while it is possible to challenge established doxa – and indeed many challenges from practitioner-researchers have seen adjustments within the academy – these fundamental tenets of academic research as they have emerged in the modern scientific tradition since the Enlightenment would be hard to shift, even were it desirable to do so.²⁴

While few artists associate their research explicitly with scientific discourse, traces of the scientific method endure in curricular and assessment frameworks for PaR in academia. The perseverance of scientific discourse

in PaR is evident in seemingly innocuous imperatives for practice-based researchers to identify research questions, objectives, methods, and contributions to knowledge. In the same vein, the recent ‘Florence Principles on the Doctorate in the Arts’ published by the *European League of the Institutes of the Arts* (ELIA), specifies that PaR doctorates must “[comply] with the prerequisites for a PhD, as formulated in the sciences and humanities.”²⁵ The report states further:

[...] that all which holds true for doctoral research and the establishment of doctoral studies [...] is also valid for doctoral studies in the arts. As different as research results might appear to be, the processes, epistemological drive and consistency with which research projects in the arts are undertaken remain the same.²⁶

Similarly, the ‘White Paper’ published by the *Académies de Musique et Musikhochschulen* insists that: “Artistic Research should aspire to the same procedural standards that apply across the whole research spectrum – replicability (especially of procedures), verifiability, justification of claims by reference to evidence” – although they subsequently soften this claim of comparative rigour by pointing “to the individual and subjective nature of artistic practice.”²⁷

As *disciplined* artists, what is it that we hope to gain by insisting that artistic practice is, or can be, research? Conversely, what do academic communities hope to gain by convincing artists to pursue and present their activities in the frame of PaR?

Foucault muses at the motives – as well as the consequences – when researchers (in his example Marxists, but this is equally relevant to artists), attempt to equate their practice with scientific methodology and discourse:

What types of knowledge do you want to disqualify in the very instant of your demand: ‘Is it a science?’ Which speaking, discoursing subjects – which subjects of experience and knowledge do you then want to ‘diminish’ when you say: ‘I who conduct this discourse am conducting a Scientific discourse, and I am a scientist’? Which theoretical-political *avant garde* do you want to enthrone in order to isolate it from all the discontinuous

forms of knowledge that circulate about it? When I see you straining to establish the scientificity of Marxism I do not really think that you are demonstrating once and for all that Marxism has a rational structure and that therefore its propositions are the outcome of verifiable procedures; for me you are doing something altogether different, you are investing Marxist discourses and those who uphold them with the effects of a power which the West since Medieval times has attributed to science and has reserved for those engaged in scientific discourse.²⁸

Through the continual transposition of value systems from the sciences to the humanities to the arts within curriculum and assessment frameworks, PaR advocates invest the discourse of PaR – and also themselves as upholders of PaR – “with the effects of a power which the West since Medieval times has attributed to science and has reserved for those engaged in scientific discourse.”²⁹ Invested with this discursive power, advocates of PaR enforce the boundaries of PaR by differentiating practice itself, from practice that is research.

Evaluating PaR

In recent years there has been much debate regarding how to demonstrate and evaluate rigour in PaR. Such debate, raised at symposia and on blogs, relates to institutional imperatives for knowledge production, such as those set forth by the Research Excellence Framework (REF) in the United Kingdom.³⁰ On a blog titled ‘The Future of Practice Research,’ Ben Johnson outlines three key pressures faced by practice researchers: 1. “the pressure to demonstrate value for money;” 2. “the pressure to align practice-based research with institutional strategies;” and 3. “the pressure to identify and engage with a wider research ‘standard’ or ‘definition’ that comes from practising in a university context.”³¹ On this same blog, a post by Victor Merriman responds to the question: “how can we best demonstrate excellence in practice research,” stating: “The short answer is that the international academic standard for excellence – rigorous peer review – should be applied, and subject associations should be approached to test levels of interest in piloting practice research peer review networks.”³² This sentiment is furthered in the European University Association’s ‘Salzburg II Recommendations’ with regards to peer review

as integral to the “[assessment] of the academic quality of doctoral education” with “[sensitivity] to disciplinary differences.”³³

In 2015, the *Journal of Studies in Theatre and Performance* announced a new section titled ‘Curating Practice-as-Research,’ the goal of which is to “evidence the methodological rigour and the research imperative of PaR projects that, ultimately, should strive towards the production of new knowledge.”³⁴ In the call for contributions, Rachel Hann and Victor Ladron de Guevara state that suitable projects, submitted in the form of a “curated portfolio,” will be peer reviewed based on their ability to identify clear research questions and aims, and contextualize the work in relation to previous scholarship and artistic practice.³⁵ Regarding curated portfolios, Hann emphasizes in a blog post that:

The narrative of the research project is paramount. Yet, it is also to be concise and to the point – we are not, necessarily, interested in two hour long videos [...]. It is vitally important that these documents offer a clear organisational principle and allow individuals to move in and out of particular sections. Ideally, a reader should be able to skip content in a logical manner, as well as pick up from when they left off. The experience should not be too far removed from the manner in which we are able to navigate a book. Nevertheless, the focus must remain on evidencing the knowledge claims. Additional information relating to a full documentation of a performance, for instance, is supplementary.³⁶

The insistence in this description of PaR portfolios on adhering to traditional organizational principles, as well as a conventional time scale for reviewing, is an example of transposing the value system of one research culture onto another. This transposition of values is not only a prohibitive act, but rather, involves the continual differentiation of the boundaries within which certain articulations of knowledge become elevated “in order to isolate [them] from all the discontinuous forms of knowledge that circulate about [them].”³⁷ In PaR frameworks in which artist-researchers are encouraged, often by other artist-researchers, to evidence knowledge claims in a “logical manner” that is similar to the “manner in which we are able to navigate a book,” the exclusion of alternative modes of articulation acts to sustain the boundaries within which practice-as-research *is*

research. Positioning the documentation of events as well as performances themselves as supplementary to textual discourse “constrains and enables what can be said” and further, “[defines] what counts as meaningful statements”³⁸ – linguistically or otherwise – in a given conception of PaR.

My interest here is not to determine the validity of one conception of research over another, but rather, to interrogate the value systems involved in the constitution and regulation of artistic PaR in different contexts. In a certain regard, positioning artistic practice as a form of research has potential to challenge institutional and cultural notions of ‘what gets valued as knowledge’ and therefore, to expand the scope of which endeavors receive life-sustaining resources.³⁹ In another regard, the concept of PaR can be understood as a regulatory device employed within communities of practice in order to standardize practices of research within and across disciplinary cultures, in service of establishing ‘common ground’ and ‘shared knowledge.’

PaR as/and Research

When choosing to associate artistic practice with the concept of research, one may wish to consider that:

Research is one of the ways in which the underlying code of imperialism and colonialism is both regulated and realized. It is regulated through the formal rules of individual scholarly disciplines and scientific paradigms, and the institutions that support them (including the state). It is realized in the myriad of representations and ideological constructions of the Other in scholarly and ‘popular’ works, and in the principles which help to select and recontextualize those constructions in such things as the media, official histories, and school curricula.⁴⁰

To this end, the concept of practice-as-research, when differentiated only cosmetically from research itself, can act as a strategy to recruit outlying practitioners into the frame of dominant and centrist discourse, such that these new ‘allies’ – including many artists – willingly reinforce, rather than destabilize, the status quo of what counts as knowledge.

This is not to conclude, however, that artistic practice should not be associated with research, or that artistic practice does not benefit from

being positioned in academia. From an idealistic standpoint, the encounter of quantitative and qualitative research methodologies with critical and counter-methodologies, such as feminist, indigenous, and artistic practices-as-research, has potential to destabilize the boundaries of cultures of research. In turn, this destabilization may lead to unfamiliar ethico-onto-epistemological entanglements – in other words, ‘new worlds,’ in which other(ed) knowledges becomes visible.

Addressing different ways of knowing in PaR, especially in cases of cross and interdisciplinary collaboration, requires deconstructive methodologies and pedagogies that dismantle not only hegemonic power, but also the distributed and regulatory effects of power that sustain conceptions of knowledge within and across the boundaries of communities of practice. As Sandy Grande argues: “unless educational reform also happens concurrently with an analysis of colonialism, it is bound to suffocate from the tentacles of imperialism.”⁴¹ In a genealogical analysis of colonialism in research, the dismantling of assumptions regarding ontology, epistemology, and ethics in methodologies also calls into question the values that uphold assessment frameworks for research ‘outcomes’ as ‘original contributions to knowledge.’ Transposing the criteria for rigour and excellence from one disciplinary culture to another fails to account for knowledges that are excluded from, and invisible within, the frame of reference of a given assessment framework. Simon Jones argues that:

[...] the epistemological difficulties inherent in the phrasing of a judgment of practice-as-research are analogous to those encountered by physicists in their attempts to measure the quantum world using the experimental machinery developed to demonstrate Classical or Newtonian mechanics. The aporia between these realities – the everyday and the quantum – challenged the belief that systems could be finally known through measurement.⁴²

Encounters between disciplinary cultures, from the sciences to the humanities to the arts, require deconstructive analysis of ways in which the value systems of the respective communities have become differentiated, but not disentangled, over the course of centuries. Resisting the transposition of disciplinary norms across practices is not a matter of

critique, at least not exclusively; rather, it involves continual processes of mutual destabilization of disciplinary boundaries, in order to shift the frames of reference within which different knowledges come to matter differently for different people.

In *Science and the Modern World* (1926) Alfred North Whitehead cautions that direct critique of entrenched values systems is ineffectual:

When you are criticizing the philosophy of an epoch, do not chiefly direct your attention to those intellectual positions which its exponents feel it necessary explicitly to defend. There will be some fundamental assumptions which adherents of all the variant systems within the epoch unconsciously presuppose. Such assumptions appear so obvious that people do not know what they are assuming because no other way of putting things has ever occurred to them. With these assumptions a certain limited number of types of philosophical systems are possible, and this group of systems constitutes the philosophy of the epoch.⁴³

In Whitehead's call for subversive tactics that address change over the course of an epoch and beyond, we are reminded that even what Nelson describes as the "fundamental tenets of academic research"⁴⁴ – its assumptions – are subject to transformation over time. While glacial shifts of value systems may not be perceptible within our situated frame of reference, and are certainly not under our individual control, the distributed effects of power across epochs means that we are always already implicated in the continual stabilization and destabilization of personal-professional-political boundaries. Through our mutual differentiation as subjects, our individual frame of reference is co-constituted with and within these boundaries – not to the point of stable determination – but as a dynamic lens that is itself invisible to us.

Attending to the ethical weight of exclusion by which the boundaries of knowledge in a given practice of research – including practice-as-research – are continually enacted, illuminates the invisible values of its advocates and sceptics alike, as well as its visible value within ethico-onto-epistemological entanglements.

Conclusion

As artists in academia, we have a lot to lose by questioning and deconstructing the machinery of PaR – for example our own jobs, funding, and resources – and so, we spend a lot of time defending it. After reading an earlier draft of this chapter, one of the volume editors commented:

I do think it's important to figure out how to place you and your research here. You are, of course, not at arms length from these shared frames of reference. Your work at C-DaRE (for example) is funded by such frames (as is my salary). I really like that you are biting the hand that feeds you [...].⁴⁵

As an artist in academia currently pursuing my third practice-based degree in dance (BFA, MFA, PhD), I appreciate the privilege that framing my choreographic practice as a form of research affords me in terms of interdisciplinary collaboration and mentorship, as well as time and money. I benefit from advocacy for artistic practice-as-research, and indeed participate in it. My goal is not to attack or undermine the discourse of PaR. Conversely, I want to understand the seeds of doubt that I perceive within and beyond PaR communities, and within my own work, regarding what PaR both enables and constrains in the construction of entangled knowledges.

In the introduction I asked: “Why would artistic practice *not* be considered research? Further, why would practice-as-research *not* belong in a university?” These questions were not an end in themselves, but rather a means to enter into a genealogical account of “the constitution of knowledges, discourses, domains of objects, etc.,”⁴⁶ which continually differentiate conceptions of knowledge in PaR from other “forms of knowledge that circulate about it.”⁴⁷ Within and across generations, cultures, and disciplines, the differentially constituted boundaries of practice versus research as well as practice-as-research, constrain and enable what may come to signify as an original contribution to knowledge in this domain – not once and for all – but continuously, through the distributed effects of disciplinary power within ethico-onto-epistemological entanglements.

Notes

- ¹ The discourse about PaR that I develop here is informed by and part of my long-term collaboration with composer John MacCallum.
- ² Barad, *Meeting the Universe Halfway*, 186.
- ³ Ibid.
- ⁴ Wikipedia, "Practice (learning method)."
- ⁵ Gladwell, *Outliers*, 39-40.
- ⁶ Macnamara et al., "Deliberate Practice and Performance," 1.
scholarship.rice.edu/bitstream/handle/1911/76260/Oswald_Deliberate_Practice.pdf.
- ⁷ Foucault, "The Subject and Power," 789.
- ⁸ Oxford Dictionaries. "Practice."
- ⁹ Descartes, *Meditations on First Philosophy*.
- ¹⁰ Ibid., 16.
- ¹¹ Ibid., 63.
- ¹² Bordo, *The Flight to Objectivity*, 34.
- ¹³ Ibid.
- ¹⁴ Ibid., 14, orig. italics.
- ¹⁵ Ibid.
- ¹⁶ MacDonald, *Descartes and Husserl*, 8.
- ¹⁷ Foucault, *The Order of Things*, 158, orig. italics.
- ¹⁸ Bordo, *The Flight to Objectivity*, 2.
- ¹⁹ Barad, "Posthumanist Performativity," 800-801.
www.jstor.org/stable/10.1086/345321.
- ²⁰ Foucault, *Power/Knowledge*, 117.
- ²¹ Ibid., 112.
- ²² Kershaw et al., "Practice-as-research," 63-64.
- ²³ Ellis, "Giving Up On Practice-as-research," 4.
- ²⁴ Nelson, *Practice-as-research in the Arts*, 25, orig. italics.
- ²⁵ European League, "Florence Principles," 3.
- ²⁶ Ibid., 2.
- ²⁷ Académies de Musiques, "Key Concepts for AEC Members," 3.

- ²⁸ Foucault, *Power/Knowledge*, 85, orig. italics.
- ²⁹ Ibid.
- ³⁰ Eastwood, "Future framework for research assessment and funding."
- ³¹ Johnson, *Rising to the Challenge*.
- ³² Merriman, *Reflection on Breakout Session 1*.
- ³³ European University Association, "Salzburg II Recommendations," 6.
- ³⁴ Hann and Ladron de Guevara, *Curating Practice-as-Research*.
- ³⁵ Ibid.
- ³⁶ Hann, *Practice Matters*.
- ³⁷ Foucault, *Power/Knowledge*, 85.
- ³⁸ Barad, "Posthumanist Performativity," 800-801.
www.jstor.org/stable/10.1086/345321.
- ³⁹ Riley and Hunter, "Introduction," xv.
- ⁴⁰ Smith, *Decolonizing Methodologies*, 8.
- ⁴¹ Grande, "Red Pedagogy: The Un-Methodology," 236.
- ⁴² Jones, "The Courage of Complementarity," 30.
- ⁴³ Whitehead, *Science and the Modern World*, 17, qtd. in Gillett, "Reduction and Emergence in Science and Philosophy," 1.
- ⁴⁴ Nelson, *Practice-as-research in the Arts*, 25.
- ⁴⁵ Personal communication with Simon Ellis, 2017.
- ⁴⁶ Foucault, *Power/Knowledge*, 117.
- ⁴⁷ Ibid., 85.

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Biography

Teoma Naccarato (Canada/UK) is a choreographer and interdisciplinary arts researcher. Through collaborative creations for stage and installation she explores the appropriation of surveillance and biomedical technologies in contemporary dance and performance practices. Naccarato holds an MFA in Dance and Technology from the Ohio State University, and is presently pursuing a practice-based PhD at C-DaRE, Coventry University.

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Appendix D

MacCallum, J. and Naccarato, T.J. (2019) ‘Collaboration as Differentiation : Rethinking Interaction Intra-Actively’. *Performance Philosophy* 4 (2), 410–433



PERFORMANCE
PHILOSOPHY

COLLABORATION AS DIFFERENTIATION: RETHINKING INTERACTION INTRA-ACTIVELY

JOHN MACCALLUM INRIA, CNRS, UNIVERSITE PARIS-SACLAY
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Wherever you are, imagine three other people sharing the space with you. They are seated on the floor, legs crossed, backs straight, eyes closed, hands on knees, wearing loose-fitting skin that is not their own. They are breathing slowly and calmly but deeply and audibly. They are wearing headphones that indicate when to inhale and when to exhale. Their breath is regular; they take precisely six seconds to fill their lungs to capacity, and then another six seconds to completely void their lungs of air. Take a few breaths with them...in for six seconds...out for six seconds...in...out. It's ok if the imposed regularity of the clock is uncomfortable, it's supposed to be. This is not normal involuntary breathing, nor is it Pranayama, nor is it recovery from physical exertion. It's an exercise in aligning a bodily process to one of mechanical regularity.

PRELUDE: CHOREOGRAPHY, COMPOSITION, AND INTERACTION

As composer-choreographer, we create work for stage and installation that is often described as “interactive performance,” perhaps owing to our use of technologies for biosensing and motion-tracking. Through our appropriation, use, and misuse of technologies from other disciplines, we have become implicated in cross-disciplinary discourse regarding interaction, and interaction design. We must acknowledge from the outset, however, that we do not believe there is such a thing as performance without interaction, or performance without technology. We employ the terms “interaction” and “technology” in their broadest senses and with intentional ambiguity to evoke the multiplicity of meanings they perform in different disciplinary contexts (music, dance, computer science, physics, chemistry, statistics). This paper is an attempt to interrogate assumptions regarding interaction within our own and other disciplines as a way of caring for our relationship to these fields. Our interest here is not to define interaction, nor to challenge or critique existing interpretations of the term. We also do not desire a common language across disciplines, such that we may design interaction together in a way that we all appear to understand, at the expense of collapsing the specificity of our different perspectives. As choreographer-composer traversing disciplinary cultures, what we are after, really, are strategies for interdisciplinary collaboration that resist subjugation of viewpoints and that not only tolerate, but rather require *critical* difference between practices to thrive.

We begin by arguing that the concept of “interaction” can only take on meaning in a situated context and is therefore an object subject to design. We look to Karen Barad’s notion of “intra-action” as a way of framing the process of constructing concepts such as “interaction” and “things that interact,” as well as the concept of “intra-action” itself (Barad 2007). From that viewpoint, we then discuss Susan Leigh Star’s concept of “boundary objects,” which, since its introduction in 1989, has become an important tool in the analysis of collaborative work. One of our goals in this discussion is to better understand how the concept of boundary objects relates to consensus and difference. Finally, we propose a practice of “critical appropriation” in which we assert that all use of technology (broadly construed) involves appropriation—an act of taking and making our own. Sustained attention to the ongoing act of appropriation, always already underway through use, is a practice of care for the multiplicity of that which is being used, and more generally, a practice of care for difference.

Move closer to one of the breathers, and sit down on the floor so that your knees are almost touching theirs. Really try to match the regularity of the breathing of the person directly in front of you. Now reach into the chest of this person. Through the skin that is not theirs, between the bones, and find their heart. Hold it with both hands as you continue to synchronize your breath with theirs.

HAUNTED BOUNDARIES [OF OBJECTS]

Composers, choreographers, architects, engineers, city planners, human computer interaction designers, all construct technologies (public spaces, machines, software, choreography, buildings, compositions) that restrict and encourage different types of behavior in time. Across these and myriad other disciplinary practices, the approach of any designer to shaping relationships between “things” (e.g. bodies, data, or ideas), positions the designer in relation to these “things” as objects of interaction, without precluding the designer being one of these objects. This design process is grounded in understandings of what these things *are* as objects of interaction, and therefore, what they *can do*, that are rooted in the conceptual frame and intentions of the designer. Many aspects of this conceptual frame may remain tacit and implicit throughout the design process—ideas about humans, non-humans, bodies, machines, technology, interaction, computation, space, time, gender, race, etc. Approaching interaction design by engaging in processes intended to make these aspects of the conceptual frame, and the values that underlie its construction, explicit, offers opportunities to treat these constitutive differences which bound conceptions of “things” as objects themselves in the design process.

We propose that interaction design be coupled with *intra-active* design, i.e. a continual and explicit engagement in the local production of subjectivity, which positions the interaction designer as an entity in the context of interaction. The concept of “intra-action” is not offered here as a replacement for, or redefinition of “interaction.” Each of these concepts only becomes meaningful through its situated use and utility, which is defined, in part, by its continual differentiation from the other. By differentiating between interaction and intra-action we do not arrive at a binary explanation; rather, the concepts of interaction and intra-action only come to matter *intra-actively* in a given design practice. Interaction and intra-action become entangled in any examination of the ways in which the value systems of the designers have become inscribed within the technologies and techniques of an interactive system. For example:

Imagine that we wish to design a device like the Microsoft Kinect—an array of cameras and microphones with a microprocessor that produces an estimate of the number of human bodies in its field of vision and a representation of the positions of the joints of those bodies. During the design process the designers must answer, implicitly and/or explicitly, questions concerning what constitutes a human body and how it will be represented. Does it have four limbs? If not, how many can it have? Can it be in a wheelchair? A bed? What types of clothing can it be wearing? The designers also must ask where a body can be—can it be outside? Underwater? Is the body free to move through the same physical space as the device we are designing, or is it encumbered by the limits of the field of vision of the cameras? Answers to these questions, and no doubt a host of others, describe what bodies *are* and *can do* from the viewpoint of the object to be designed. As the object is built, these *descriptions* become *inscribed* in the hardware, software, operating instructions, training videos, etc., and ultimately produce a set of *prescriptions* for *how, where, and what to be and do* if one wishes to be identified as an object of interaction in this context.

These prescriptions delimit the boundaries of a community populated by those who are able, willing, and interested to participate in interaction as put forward by the designers of a given technology. They are the foundations of culture, discipline, knowledge, and power in this community, and construct the group of objects available for interaction, as well as the locally-derived concept of interaction itself. In this paper, we shift our focus from the design of interaction between objects to the situated design of the culture organizing things that interact. This requires attention to those aspects of interaction design concerned with the construction of boundaries for the purposes of organizing objects of interest.

Cultures and their constituent parts—disciplines, knowledge, subcultures, politics, conflicts, etc.—are not stable, and cannot be represented in their totality through any means. The process of referencing a community, a culture, a discipline, is a process of stabilization through various forms of in-, ex-, oc-, and transclusion. This process is the construction of a social object belonging to the community engaged in observation and reference; to say that this object is distinct from the community being observed would be to engage in a second processual construction of a community as a social object. Such an object, related to Durkheim's concept of a "social fact," is itself a process in relation with those engaged in its construction, and, as such, may not be referenced or represented in its totality. The relationship of these societies with those who construct them depends on the ways in which their borders have been designed to include, exclude, occlude, or transclude their designers.

Judith Butler points to the haunting of constructed borders by all that has been rendered invisible, yet remains (1993, 8). The absent presence of objects of non-interest is what stabilizes interpretations of objects of interest within a locally-derived system of interaction. That which constitutes a body in the eyes of the Kinect (or more generally, that which constitutes a body or object of interest in a system of classification), is set against that which it views as lacking bodily coherence, a view that overlaps with that of the designers. This body and other-than-body require one another in order to differentiate their ontologies through an ongoing process of constitutive constraint, which is never resolved once and for all. It warrants consideration then: "Given this understanding of construction as constitutive constraint, is it still possible to raise the critical question of how such constraints not only produce the domain of intelligible bodies, but produce as well a domain of unthinkable, abject, unlivable bodies?" (xi). Through their shared becoming, bodies of interest and bodies of non-interest remain entangled and intra-active, haunting one another as exteriorities within, resisting binary designation, and threatening the sovereignty of the local system of interaction. The "filtered-out" bodies, gestures, and "noise" of an interactive system remain integral to the coherence and operation of that system. Reiterating, with difference:

it is not enough to claim that human subjects are constructed, for the construction of the human is a differential operation that produces the more and the less "human," the inhuman, the humanly unthinkable. These excluded sites come to bound the "human" as its constitutive outside, and to haunt those boundaries as the persistent possibility of their disruption and rearticulation. (8)

When the sanctity of the objects of interest is undermined by the absent presence of their obligatory others, the designer must look beyond the discretized frame of interaction, towards the continual field of intra-action of which they themselves are part.

Bring your attention to the gradual changes in tempo of the heart you are holding. Speeding up as the lungs are filled, slowing down as the breath is released. Stay here for a moment, just focusing on the gradual shifts in tempo of the heartbeat with the breath.

Now bring your attention to the pulses themselves, those movements that fill your hands and produce tempo. Feel the ways each beat marks and divides the breath, and the ways the breath groups the beats. Perhaps those groups begin to take on character, shape, meter.

Take note of moments when a beat happens to occur at the moment of a transition from an inhale to an exhale, or an exhale to an inhale. Or a beat that happens to perfectly divide the breath into equal halves.

Now bring that same attention to the beats that fall in relations with the breath that are not so simple to categorize. Moments when the beats seem to be floating against the metrical regularity of the breath, before they lock back in briefly, only to float away again.

INTRA-ACTIVE DESIGN AS COLLECTIVE SUBJECTIVATION: FROM CAUSALITY TO ENTANGLEMENT

Intra-action is a neologism coined by Karen Barad which she describes as signifying “the mutual constitution of entangled agencies” and can be understood as shifting the focus from the individualistic notion of things interacting and cause/effect dualism to the material-discursive production of subjects and objects that intra-act (2007, 33). In her article “Quantum Entanglements and Hauntological Relations of Inheritance: Dis/continuities, SpaceTime Enfoldings, and Justice-to-Come,” she elaborates:

In contrast to the usual ‘interaction’, the notion of *intra-action* recognises that distinct entities, agencies, events do not precede, but rather emerge from/through their intra-action. ‘Distinct’ agencies are only distinct in a relational, not an absolute sense, that is, agencies are only distinct in relation to their mutual entanglement; they don’t exist as individual elements. Importantly, intra-action constitutes a radical reworking of the traditional notion of causality. (Barad 2010, Note 1, 267, original italics)

While discourse about interaction, itself a thing, requires things that interact, discourse about intra-action involves processes of stabilization and destabilization (of these processes), the continual

making and unmaking of things. Whereas things like interaction are often visualized using arrows to represent information moving from one object to another, an aspect of intra-action concerns the way in which those arrows and their directionality get constructed—the notion of cause and effect is replaced by entanglement.

Similar ideas can be found in the writings of Deleuze and Guattari:

Mimicry is a very bad concept, since it relies on binary logic to describe phenomena of an entirely different nature. The crocodile does not reproduce a tree trunk, any more than the chameleon reproduces the colors of its surroundings. The Pink Panther imitates nothing, it reproduces nothing, it paints the world its color, pink on pink; this is its becoming-world, carried out in such a way that it becomes imperceptible itself [...] ([1980] 1987, 11)

It is not enough here to reverse the arrows and say that the tree trunk reproduces the skin of the crocodile—that is simply a judgment made from another perspective framed by mimicry, imitation, reproduction, evolution, etc. Another way to say this is that the chameleon is a process in continual change (becoming), and as such cannot be represented through any means, material, discursive, or otherwise. When we label it “the chameleon” and discuss what it may or may not be doing when it “changes color,” we have produced a necessarily incomplete representation of it—a new object—that omits an infinitude of aspects that fade into imperceptibility. What was omitted was done so due to our context, our frame of reference, and our current set of intentions concerning our construction and use of the chameleon (*i.e., making a point in this paper*).

Conceptual shifts such as these are radical as they are invitations to uproot the settled knowledge and resolved disputes of a discipline, to probe those aspects of disciplinary knowledge that ground practice. Just such a shift formed the basis of the approach to what Félix Guattari and Jean Oury referred to as “institutional psychotherapy” as practiced at the psychiatric clinic of La Borde since the 1950s where “everything there is set up so that psychotic patients live in a climate of activity and assume responsibility, not only with the goal of developing an ambience of communication, but also in order to create local centres for collective subjectivation. Thus it’s not simply a matter of remodeling a patient’s subjectivity—as it existed before a psychotic crisis—but of a production *sui generis*” (Guattari 1995, 6). This approach has profound implications not just for the working methods of the institution, but the institution itself: “one could not consider psychotherapeutic treatment for the seriously ill without taking the analysis of institutions into account. Reciprocally, the conception of individual treatment came to be revised, bringing greater attention to the institutional context” (Guattari 2015, 61). Guattari’s views represent a turn away from individualism:

So we are proposing to decentre the question of the subject onto the question of subjectivity. Traditionally, the subject was conceived as the ultimate essence of individuation, as a pure, empty, prereflexive apprehension of the world, a nucleus of sensibility, of expressivity—the unifier of states of consciousness. With subjectivity, we place the emphasis instead on the founding instance of intentionality. This involves taking the relation between subject and object by the middle and foregrounding the expressive instance. (Guattari 1995, 22)

In the context of interaction design, “taking the relation between subject and object by the middle” requires letting go of interpretations of mimicry and causality between pre-constituted “things.” Only through their differentiation within processes of subjectivation and intra-action do discrete “things” *become*, and therefore become available as objects that can be made to interact.

Continuing to stay attentive to the complex temporal relationship between the breath and the heart, begin to imagine the hearts of the other two breathers in the room with you. Imagine that although their breathing is the same as the person in front of you, and their hearts follow similar patterns of acceleration and deceleration, the three of them produce a complex counterpoint of pulses out of which you find yourself in the continual process of making and unmaking rhythmic patterns, all against the cantus firmus of the breath.

INTERLUDE: WHAT-WE-MEAN-BY-INTERACTION

We pause here to bring awareness to our own process of weaving together appropriated passages of text by immanent philosophers in order to construct a narrative that is ours, not theirs, and designed to convince you the reader to consider our frame of reference. These authors and passages have been chosen strategically not just for the profundity of their ideas, but with full knowledge of our use of their discursive gravity as a technology of power. “My inhibitions, as you can see, can be expressed only by being dressed up in external statements, and now that I am using quotations as weapons of debate, I will offer some more in the hope of salvation” (Guattari 2015, 208):

Discourse is not what is said; it is that which constrains and enables what can be said. Discursive practices define what counts as meaningful statements. Statements are not the mere utterances of the originating consciousness of a unified subject; rather, statements and subjects emerge from a field of possibilities. This field of possibilities is not static or singular but rather is a dynamic and contingent multiplicity. (Barad 2003, 819)

Discourses are not once and for all subservient to power or raised up against it, any more than silences are. We must make allowance for the complex and unstable process whereby discourse can be both an instrument and an effect of power, but also a hindrance, a stumbling block, a point of resistance and a starting point for an opposing strategy. Discourse transmits and produces power; it reinforces it, but also undermines and exposes it, renders it fragile and makes it possible to thwart it. (Foucault [1976]1990, 100–101)

To what extent does discourse gain the authority to bring about what it names through citing the conventions of authority? And does a subject appear as the author of its discursive effects to the extent that the citational practice by which he/she is conditioned and mobilized remains unmarked? Indeed, could it be that the production of the subject as originator of his/her effects is precisely a consequence of this dissimulated citationality? (Butler 1993, xxi)

Papers such as these are often described as contributions to this or that field; however, in consideration of the frame of reference established in the previous sections, we must acknowledge the inherently intra-active nature of such a contribution. We see this work as a contribution to the discourse intended to shape the contexts in which conceptions of “interaction” and “things that interact” are produced. The production of a definition of “interaction” is the production of subjects included within the boundaries of that definition, as well as the domain of the excluded, who come to haunt that boundary. The design of interaction necessarily includes becoming subject to “what-we-mean-by-interaction.”

Intra-action is related to collective modes of work such as collaboration, cooperation, coordination, teamwork, etc., but generalized to take into account that these notions themselves are produced through intra-action and that the participants, human or otherwise, are never stable, but are in continual processes of becoming and unbecoming. Intra-action can be seen as the dark matter that binds these continually changing, partially understood objects together in an ontogenetic becoming-universe.

The primary question with which we are concerned is how, and to what extent, we may design that universe, and what is at stake in the choice of different approaches. In the following sections, we investigate the concepts of boundary objects, diffraction, and critical appropriation as potential approaches to intra-active design.

Return your attention to the pulsing heart in your hands.

IS THIS A BOUNDARY OBJECT?

In the social sciences broadly, and human computer interaction and science and technology studies specifically, the concept of “boundary objects” is often deployed to describe and facilitate interaction between communities. Introduced by Susan Leigh Star in 1989, the concept was also intended as a provocation to the artificial intelligence community to reconsider notions of what constitutes intelligence from the standpoint of cooperative work in open systems. The following year, Star and James Griesemer refined the concept, demonstrating and advocating its use as an analytical tool to frame the cooperative actions of the players involved in the early years of UC Berkeley’s Museum of Vertebrate Zoology (Star and Griesemer 1989). By way of a definition, Star and Griesemer offer the following:

Boundary objects are objects which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual-site use. These objects may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation. (Star and Griesemer 1989, 393)

Star and Griesemer write that the production and management of boundary objects “is a key process in developing and maintaining coherence across intersecting social worlds” (Ibid.). Isto Huvila goes a step further, stating that they “are a precondition for communication, cooperative work, and having reached mutual goals” (2011, 3). Star and Griesemer describe boundary objects as an expansion of what Callon called *interessement*: “*Interessement* is the group of actions by which an entity [...] attempts to impose and stabilize the identity of the other actors it defines through its problematization. Different devices are used to implement these actions” (Callon 1986, 8). While these two analytical approaches are similar, Star and Griesemer emphasize the construction and use of objects that get created to negotiate the boundaries between viewpoints rather than the processes of translation of information as it crosses boundaries.

For Star, the term “object” is meant to be understood in a variety of pragmatic, disciplinary, and material senses, as

something people (or, in computer science, other objects and programs) act toward and with. Its materiality derives from action, not from a sense of prefabricated stuff or “thing”-ness. So, a theory may be a powerful object. Although it is embodied, voiced, printed, danced, and named, it is not exactly like a [heart] that has four [chambers]. A [heart] *may* be a boundary object [...]. (Star 2010, 603, original italics)

The point being made here is that the materiality of an object, be it a theory or a heart, does not determine whether or not it is or can be a boundary object. Rather, it is the differential materialization of this object through its performance within overlapping systems and worlds, always underway and always in relation to the materialization of other objects, that informs interpretations of it as a boundary object.

Imagine a healthy, beating heart, fully functional in its capacity as an organ sustaining life in a young pig. In this capacity, it sustains the basic biological systems of the body, but also requires those same systems in order to function. Now imagine the heart, i.e. the muscle, cut from those systems and removed from the pig. Displaced from its role in the sustenance of the body in which it was grown, it is now free to be used in other ways, as food, as an object in a piece of art, or perhaps even, as seems likely at the time of this writing, it may find use as a functioning heart again, ensuring the longevity of a being from another species. The specific heart that we are imagining was one that was bought from a *triperie* in Nice; it was intended to be sold for food, and indeed, we intended to eat it, but only after filming it as an object of choreography. We spent two days exploring and filming intimate touch with each other and the heart, after which, we could no longer imagine the heart in its capacity as food.

So, is this pig’s heart a boundary object? This question requires the construction of a context in which this question matters. We could discuss its role in terms of capitalism, the geopolitics of meat consumption, animal rights. We could also discuss it in terms of its role in shaping the exploration of touch and movement in an artistic context between two people with different disciplinary backgrounds. We can also see the construction of the pig’s heart through description

and recollection for the purpose of arguing that boundary objects are always constructed *a posteriori* in order to shape the viewpoint of a peer group, rather than through use as suggested by the literature. There is a grave risk for us here that one day you may encounter the short film in which we handle the pig's heart and see it as an example used to make a claim about boundary objects, or worse, you may think that it was produced with that purpose in mind (we assure you it was not).

The point being made here illustrates a bifurcation of a boundary object into an object constructed through cooperative work, and an analytical object used to describe said work. An ethnographer studying cooperative work is also implicated in cooperative work. For the people under study, theories and other “things” have the potential to become boundary objects in the context of their cooperative work. However, when described as such by the ethnographer, these objects, along with the people that use them, may also become boundary objects in the production of knowledge between the ethnographer and the ethnographer's peer group. This is to say that the construction of a boundary object to describe aspects of collective work becomes a boundary object in the collective work practice of description. In Callon's study of the different parties involved in the preservation of sea scallops in St. Brieuc Bay, he astutely implicates the disciplinary peer group that the Japanese researchers are affiliated with as contributing to the intentions of the researchers (Callon 1986). Similarly, in order to situate this discussion of boundary objects in a larger discourse, we must implicate ourselves as part of the peer group associated with Star, Griesemer, and those others who contribute to the production of knowledge related to boundary objects.

In this very text, we appropriate the concept of boundary objects—which can itself be used as a boundary object—and employ it in order to question the capacity of boundary objects to support approaches to interdisciplinary collaboration that not only tolerate divergent viewpoints, but that require divergent viewpoints to operate and flourish. As a potential boundary object, this paper is part of a context of intra-action that includes other publications about boundary objects that are themselves potential boundary objects.

Bring as much of the palms of your hands and your fingers into contact with the surface of the heart as you can. Try to envelope it fully so that you can feel as much of the subtle complexity of its movement as possible. Let the discreteness of 'beats' dissolve into continuous and continual waves of pulses. Feel them travel across, through, between your hands. Try to imagine that in the smallest movements, the ones barely perceptible, the heart is gathering the energy it needs to beat. Now imagine that you can increase that energy by squeezing it in those moments between the beats, pushing energy into the heart, and receiving it back in your hands when it beats.

HAUNTED BOUNDARIES [OF BOUNDARY OBJECTS]

Star and Griesemer assert the “fundamental sociological finding” (1989, 388) that consensus is not necessary for cooperation; however, their text belies the belief that some form of reconciliation of differing viewpoints is necessary for cooperation:

Consensus is not necessary for cooperation nor for the successful conduct of work. [...] However, scientific actors themselves face many problems in trying to ensure integrity of information in the presence of such diversity. [...] When the worlds of these actors intersect a difficulty appears. The creation of new scientific knowledge depends on communication as well as on creating new findings. But because these new objects and methods mean different things in different worlds, actors are faced with the task of reconciling these meanings if they wish to cooperate. This reconciliation requires substantial labour on everyone's part. Scientists and other actors contributing to science translate, negotiate, debate, triangulate and simplify in order to work together. (Star and Griesemer 1989, 388–389)

The characterization that diversity causes problems, that the intersection of worlds creates difficulty, situates the concept of boundary objects as the key to reconciling these meanings so that communication can occur and new scientific knowledge can be created. Boundary objects are positioned as passage points through which information must flow for cooperative work to produce knowledge. What a reconciliation of viewpoints implies, and the ways it differs from consensus, has been examined by Huvila who writes that, “the creation or reshaping of a boundary object is always an attempt to make a hegemonic intervention” (2011, 21). He elaborates:

the boundary object and boundary crossing have a purpose. This purpose, even a very lenient one, is an attempt to influence adjacent communities and as such a more or less belligerent form of hegemonic intervention. [...] A specific characteristic of a boundary object is that it makes hegemonic interventions easier to accept for communities with antagonistic tendencies even if the emerging norm would be advantageous by default only from the point of view of the hegemonic position. Boundary objects may thus be seen as facilitators of hegemonic interventions of different levels embedded in the boundary practices of interfacing communities. (Huvila 2011, 21)

The construction of this hegemonic relationship is the construction of a particular type of interaction, which itself occurs in the context of intra-action and the production of truth/power. While the subjugation or assimilation of viewpoints as they funnel through the passage point of the boundary object may be consensual or even welcome, the dynamics of boundary crossing cannot be interpreted outside of the operation of power. In Foucault's estimation:

In itself the exercise of power is not violence; nor is it a consent which, implicitly, is renewable. It is a total structure of actions brought to bear upon possible actions; it incites, it induces, it seduces, it makes easier or more difficult; in the extreme, it constrains or forbids absolutely; it is nevertheless always a way of acting upon an

acting subject or acting subjects by virtue of their acting or being capable of action.
A set of actions upon other actions. (1982, 789)

What Huvila is effectively proposing is a category of boundary objects that we might call “hegemonic boundary objects” that are used to conduct and describe collective work that is based in particular assumptions about productivity rooted in Capitalism. The production of these hegemonic boundary objects in analytical discourse reflects the analyst’s frame of reference, intra-active context, and operations of power. Actions are not themselves *a priori* hegemonic in nature; the determination that an action is or was hegemonic is a situated one that requires the production of a subjectivity in which the action *becomes* hegemonic.

While our purpose here is to highlight the subjective nature of such a determination in order to invite discourse about other possible subjectivities, doing so pushes us into delicate ethical territory where questions of accountability and responsibility must be raised, both with respect to the act deemed hegemonic, and the act of deeming an act hegemonic. The proposition that these determinations are situated in one’s subjectivity does not imply absolution of responsibility; on the contrary, their production is entangled with questions of responsibility. Responsibility requires things to be responsible to, and the production of those things cannot be distinguished from acts of responsibility.

In a similar vein to Huvila’s account of boundary objects as hegemonic interventions, Kathryn Henderson describes “conscription devices” as visual representations used to enlist and organize participation in collective work. She states: “Since visual representations are located at the center of power, they are the locus of action, which may be negotiation and consensus, or it may be conflict and power plays” (1999, 134). This notion of power, limited in its conceptual and geographic reach by its ocularcentrism, is very different than Foucault’s “total structure of actions brought to bear upon possible actions” (1982, 789). Power cannot be reduced to control. The characterization of power as a central hub (i.e. a conscription device), that mediates between the interests of parties during interaction, is a colonialist narrative: it fails to acknowledge the continual, intra-active construction of the haunted boundaries of these objects, as well as the infrastructures they traverse.

Elaborating on the concept of boundary objects, Bowker and Star discuss “boundary infrastructures” as “objects that cross larger levels of scale than boundary objects” to “deal with regimes and networks of boundary objects (and not of unitary, well-defined objects)” (Bowker and Star 1999, 313). They explain that, “[w]hat we gain with the concept of boundary infrastructure over the more traditional unitary vision of infrastructures is the explicit recognition of the differing constitution of information objects within the diverse communities of practice that share a given infrastructure” (314). While “scaling up” from objects to infrastructure (another type of object, in our estimation) grants perspective on the systemic operations of power, the plasticity and translatability of a boundary infrastructure between communities still requires the management of “divergent viewpoints” by way of “accommodations, work-arounds, and in some sense, a higher-level of artful integration” (292).

To this end, we inquire: just how little overlap, or conversely, just how much difference can a boundary object, conscription device, or boundary infrastructure tolerate before one's notion of cooperation or collaboration breaks down?

In her 2007 article "Boundary Negotiating Artifacts: Unbinding the Routine of Boundary Objects and Embracing Chaos in Collaborative Work," Charlotte Lee provides a substantial critique of the community's adoption and use of boundary objects. In her estimation, the problem lies not in the conception of boundary objects themselves, but rather in the "tendency of researchers to label every artifact [that moves between communities of practice] a boundary object" because "it forces us to deny what we observe, to ignore the finer points of the boundary object definition, or to awkwardly wrap new theories around the [definition of boundary objects]" (2007, 314). Lee points out that in their original conception, "ultimately boundary objects was posited as a creature based on established standards" and that "[t]he dependence of boundary objects on the premise of established standards is inherently problematic for theorizing incipient, non-routine, and novel collaborations" (Ibid.). To account for artifacts that exist in "projects that are fairly non-routine and fairly complex," Lee introduces the term "boundary negotiating artifacts" (334). What is at stake in her critique of her community's (over)use of boundary objects is the neglect of work practices that do not appear similar to those that gave rise to boundary objects in the first place. Or worse, perhaps, that the study of "incipient, non-routine, and novel collaborations" will be misconstrued, a risk that puts her community's knowledge on shaky foundations.

In her conclusion, Lee questions whether the focus on "standardized artifacts and stable organizational contexts" is due to them being "most easily codified into our computational systems" (336). While this is surely not the only reason, it highlights the role of the observer, the person ultimately responsible for the construction of boundary objects / boundary negotiating artifacts. A description of a boundary object or a boundary negotiating artifact is an expression of the frame of reference from which the observer views the world, an expression that is then performed by the reader in the context of the discourse that constitutes the practice of boundary object production.

In the framing of boundary objects, boundary negotiating artifacts, and boundary infrastructures as a means for cooperation and reconciliation—in service of a shared goal or greater good—the non-neutrality of the boundary as common territory must be taken into account. Designating a border territory or "common ground" for passage and translation between communities requires the drawing of a boundary around this shared space that may not be symmetrical in its inclusivity and reflectivity of interests. When cooperation, reconciliation and collaboration are promoted under the guise of accessibility and diversity, it is important to shed light on colonial and capitalist imperatives to standardize methods and maximize productivity through the self-regulatory and disciplinary effects of power.

While the concept of boundary objects (and its variants) tolerates some degree of difference, it cannot accommodate irreconcilable difference in which there is no reflection of viewpoints between communities. By requiring mirrored interests as the basis for plasticity and

translatability—and therefore visibility—the framework of boundary objects positions difference in opposition to similarity, and dissent against consensus.

In time with the person whose heart pulses in your hands, gradually begin to accelerate the pace of your breathing, fully emptying and filling your lungs with each breath. In through your nose, out through your mouth. As you continue to speed up, taking in much more oxygen than your body needs, you may find that the air feels cold in your nose, in your throat, in your chest. Continue faster still. Your fingers may begin to tighten and curl, locking on to the heart. This is normal, it will pass. Faster still. Feel the heart in your hands beat faster and more regularly as both of you continue to accelerate. Inhale, exhale, inhale, exhale, inhale.

INTERLUDE: A FAILED ATTEMPT AT REFLEXIVITY

Here's the thing. Boundary objects are frightening for us because they represent what we perceive to be a practice of colonizing knowledge by recharacterizing it in order to serve the needs of a different community. What we have to account for now is the way in which we performed exactly the same act in order to make our point about it.

Our intent as authors, if such a thing can be trusted, is not to interact with you, the reader, through the transmission and translation of ideas towards shared understanding. We simply do not believe that such authority exists. And yet, our authorial attempts to reflexively account for our role in this discourse are not sufficient to reveal our own sense of intentionality, for in reflexively reflecting ourselves back to ourselves, we cannot but see our own vision of ourselves.

[R]eflexivity is nothing more than iterative mimesis: even in its attempts to put the investigative subject back into the picture, reflexivity does nothing more than mirror mirroring. Representation raised to the *n*th power does not disrupt the geometry that holds object and subject at a distance as the very condition for knowledge's possibility. Mirrors upon mirrors, reflexivity entails the same old geometrical optics of reflections. (Barad 2007, 87)

The problem is that a reflexive accounting of ourselves as authors in the story we are trying to tell never really brings new information to that story, it simply tells a different story, one that includes us, an accounting for which we must account, reflexively, on and on.

What we must do is bring into question the intra-actively enacted boundaries of ourselves as selves with the authorial capacity to produce an object such as this text, or a shared goal such as this: *As authors we seek to articulate approaches to design, in and between multiple communities of practice, that not only tolerate difference, but rather, that require critical difference between practices in order to thrive.*

Our use of the term *critical* here and elsewhere is an amalgam of its definitions and stands in for the assertion that the noun it describes matters in a given context. It is not enough to speak of difference, but rather difference that has crossed an inflection point, difference that has been brought to a point of critical mass, difference that is essential to a context and that must be cared for in order to prevent it from becoming flattened.

In caring for the critical differences that emerge in our designing of interaction as composer-choreographer, we desire strategies that are not based on critique, for as Barad reminds us:

Critique is all too often not a deconstructive practice, that is, a practice of reading for the constitutive exclusions of those ideas we can not do without, but a destructive practice meant to dismiss, to turn aside, to put someone or something down—another scholar, another feminist, a discipline, an approach, et cetera. (Barad 2012, n.p.)

Our critique in the preceding sections is not a critique of the *concept* of boundary objects, rather it is a critique of the *act* of constructing boundary objects. Such an act involves the construction of a community, a practice, and a discourse through the making of their boundaries, and what we have tried to show is that the making of those boundaries is the expression of value systems. The problem is that in order to express our critique of these kinds of acts, we first had to construct a community, a practice, and a discourse in which these acts were performed. It's not enough to say that we did this—to admit our culpability—nor is it enough to point out that the act of critique is an act of making communities that can be critiqued. When communities are made, they are always in relation to the things they are not, including the continual acts of their making, and our goal here is to foreground, so that we may better care for, the relationships that ultimately form these communities.

In search of approaches to designing interaction that bring awareness to the value systems involved in the local production of “interaction” and “things that interact,” we appropriate Barad's appropriation of “diffraction” (from quantum physics into agential realism), as a method to examine “patterns of difference that make a difference” between communities of research. Further, we discuss the potential value of what we term “critical appropriation,” i.e. the re-contextualization of technologies across disciplinary boundaries, with care for perceived transgressions of the ethical norms that govern notions of proper use and mastery in the respective domains. Our use of the term “appropriation” is itself an appropriation and repurposing of this term to resist, rather than facilitate, the colonizing of knowledge by recharacterizing it in order to serve our own needs. Following the logic developed so far in this text, our interpretation of the concepts of diffraction and critical appropriation can only be understood through ongoing intra-action with concepts introduced earlier in the text, such as interaction, reflexivity, and boundary objects.

Hold your breath.

DIFFRACTION: CRITICAL DIFFERENCE AND RESPONSIBILITY IN COLLABORATION

Barad builds on the metaphor of “diffraction,” proposed by Haraway (1992), as a strategy to resist framing the “geometrical optics of reflection” as the source of difference between phenomena (Barad 2007, 87). Whereas reflection involves the bouncing back of a wave (e.g. of a light, water, or sound wave) from a surface, diffraction is the changing of direction of this wave as it passes around the edges of an obstacle or through a narrow opening. As a wave in the ocean encounters a rock that breaks the surface, the wave bends around the rock and interferes with itself on the other side. The effects of this interference are as much the result of the characteristics of the wave as they are of the size and shape of the rock. Unlike mirrors which produce images of objects placed at a distance, “diffraction gratings are instruments that produce patterns that mark differences in the relative characters (i.e., amplitude and phase) of individual waves as they combine” (81). In appropriating the concept of diffraction in order to investigate how different differences come to matter, Barad highlights that:

[diffraction] is not just a matter of interference, but of entanglement [...] There is not this knowing from a distance. Instead of there being a separation of subject and object, there is an entanglement of subject and object [...] instead of being about offering an undistorted mirror image of the world, it is about accountability to marks on bodies, and responsibility to the entanglements of which we are a part. (Barad 2012, n.p.)

This warrants emphasis: by deconstructing notions of reflexivity, individuals and institutions are not absolved of responsibility for the ways in which they are entangled with “others,” for these others, to repeat from Butler, are what come to bound their “constitutive outside, and to haunt those boundaries as the persistent possibility of their disruption and rearticulation” (1993, 8). Subverting hegemonic narratives of control-based interaction between subjects, the intra-active character of

diffraction patterns illuminat[e] the indefinite nature of boundaries—displaying shadows in “light” regions and bright spots in “dark” regions—the relationship of the cultural and the natural is a relation of “exteriority within.” This is not a static relationality but a doing—the enactment of boundaries—that always entails constitutive exclusions and therefore requisite questions of accountability. (Barad 2007, 135)

The enactment of boundaries does not necessarily, or perhaps ever, distribute territories and agencies symmetrically. As such, it is reductive (and potentially dangerous) to characterize power relations within and across these borders as a matter of interaction, that is, as reciprocal actions, effects, and influences. Framing interaction as reciprocal exchanges or mappings between things (people, objects, data, disciplines, cultures, etc.), does not account for shifting asymmetries between these things; it lays the foundation for subjugation by way of self-regulatory and disciplinary effects of power, and fails to implicate all participants in the “entanglements of which

[they] are part" (Barad 2012, n.p.). An important distinction between reflection and diffraction is that:

diffraction does not fix what is the object and what is the subject in advance, and so, unlike methods of reading one text or set of ideas against another where one set serves as a fixed frame of reference [i.e. interaction], diffraction involves reading insights through one another [i.e. intra-action] in ways that help illuminate differences as they emerge: how different differences get made, what gets excluded, and how those exclusions matter. (Barad 2007, 30)

Designing interaction involves the mapping of perceived difference between objects of interaction (e.g. bodies, gestures, physiological processes, media, etc.), within the frame of reference of the designers. What constitutes "difference that matters" within this locally derived system of interaction depends on the vision of the designers, which necessarily excludes types of difference that are invisible to them. Shifting focus from the reflective tactics of interaction design towards the diffractive performance of intra-action does not necessarily produce greater visibility of difference itself, for difference's sake. Haraway makes the important distinction that, "a diffraction pattern does not map where differences appear, but rather maps where the *effects* of differences appear" (Haraway 1992, 299, original italics). Mapping the effects of differences does not presume that these differences emerged from a unitary source. This is important, because it subverts the assumption that difference can only come to matter in opposition to an originary sameness. In this regard, Barad argues that:

If diffraction is to serve as an important metaphor for differences that matter, it is crucial that we pay attention to the kinds of differences that different understandings of diffraction evoke, so as to not conflate questions of accountability to differences that matter with postmodern celebrations of difference for difference's sake. (Barad 2007, 214)

In Barad's use of the term, *diffraction* stands in for at least three things: a theoretical description of the behavior of light and matter as both waves and particles; an ethnography of the development of quantum mechanics in response to a phenomenon that defied explanation in terms of classical physics; and a philosophical proposition that subject and object are not separate or separable. We are inspired by what we read in Barad's development of diffraction as a metaphor, but we must also acknowledge that we do not have the same relationship to science and philosophy that she does. Our background as choreographer-composer in no way precludes us from engaging in scientific and philosophical discourse, but we do have a different frame of reference and we are aware that the boundaries of diffraction, or rather, "what we mean by diffraction," are differently haunted for us.

Our appropriation of diffraction, and likewise boundary objects, is done to explore approaches to collective work, specifically different conceptions of interaction design such as composition and choreography, rooted in difference *qua* difference, rather than difference as defined with respect to sameness. It is an act no different than Barad's appropriation of Niels Bohr's formulation of

quantum mechanics or Star and Griesemer's appropriation of the founding of the Berkeley Museum of Vertebrate Zoology, with the possible exception that we acknowledge the aporetic act of constructing a subject in order to argue that there is no *a priori* distinction between subject and object. This is to say, this presentation of diffraction and boundary objects is based in constructions of them—constructions that we have argued throughout the entirety of the paper are shaped as much by what they include as what they exclude.

For us, this is an exercise of *critical* appropriation, which we describe as a sustained act of appropriation that is continually destabilized by the provocation that things only become things through exclusion, that what is excluded forms the basis for other onto-epistemologies, and that we bear responsibility for that which we exclude. Paraphrasing Derrida, we are “responsible to anyone (that is to say, to any other) only by failing in [our] responsibility to all the others, to the ethical or political generality. And [we] can never justify this sacrifice; [we] must always hold [our] peace about it [...] What binds [us] to this one or that one, remains finally unjustifiable” (2008, 70).

As an approach to intra-active design, what the metaphor of diffraction offers, especially to those involved in interdisciplinary collaboration, is the proposition that it is possible to work together—responsibly—not only based on a mutual goal or common ground that reflects an overlap in viewpoints, but rather, through an investigation of how and why differences have come to matter within and between individuals, disciplines, and cultures over time. Approaching collective work diffractively requires awareness of the ongoing production of difference, not only quantitatively, but aesthetically and ethically, as it transforms with and through the entangled agencies of participants.

Having discussed the potential of boundary objects and diffraction as approaches to intra-active design by interaction designers across disciplines, we now discuss our conceptualisation and practice of interdisciplinary design by way of *critical appropriation*.

Resist the urge to release. You may feel your chest move involuntarily. This is your diaphragm spasming, trying to pull air into your lungs. Try to relax, and it will pass. Keep holding.

CRITICAL APPROPRIATION: INNOVATION BY DESTABILIZATION

Critical appropriation involves the continual de- and re-contextualization of technologies (concepts, tools, techniques, etc.) between disciplinary communities, with attention to shifts in ecology and epistemology, as well as perceived ethical transgressions (Naccarato and MacCallum 2017). Whereas appropriation may be associated with the reflective tactics of interaction—displacing objects from one context to another without investigating how and why differences emerge—critical appropriation is necessarily diffractive: shifts in ecology and epistemology are positioned as objects of interaction in relation to appropriated materials. As a means to address non-consensus and conflict in interdisciplinary collaboration, critical appropriation differs from

boundary objects in that it is not intended to mitigate divergence by translating differences into shared understanding, goals, and productivity. Critical appropriation is not a matter of adaptation in which objects “are weakly structured in common use, and become strongly structured in individual-site use,” or in which “their structure is common enough to more than one world to make them recognizable, a means of translation” (1989, 393). Critical appropriation is a provocation to continue to understand objects (people, bodies, movements, gestures, concepts, disciplines, cultures, communities, infrastructures, boundaries, etc.) as inherently multiple, and to bring attention to their ontologies outside of their current subjectivity. This is not a matter of bending the ontologies of objects to fit them inside an ethico-æsthetic frame that is accessible to all parties in a project; rather, critical appropriation is entangled with “a politics and ethics of singularity, breaking with consensus” towards collective subjectivation (Guattari 1995, 117).

Importantly, a diffractive reading of boundary objects, diffraction, and critical appropriation, as well as interaction and intra-action, works to “illuminat[e] the indefinite nature of [their] boundaries—displaying shadows in ‘light’ regions and bright spots in ‘dark’ regions” as well as their “constitutive exclusions and therefore requisite questions of accountability” (Barad 2007, 135). Each proposition addresses difference, power, and collaboration from a particular orientation within an entanglement of value systems, the effects of which are in continual intra-action through our appropriation and treatment of them in this paper.

In our collaborative practice as a choreographer-composer we place emphasis on critical appropriation of biosensors in creation and performance as a means to intervene in the invisible boundaries of our own ethico-æsthetic frame(s) of reference (Naccarato and MacCallum 2017). We often use electrocardiograms (ECGs) in a variety of contexts in our work: they are worn by dancers, their amplified and processed signals are listened to by musicians, and those same signals are felt by guests invited into the work. The critical appropriation of the ECG devices, the WiFi technology used to transmit their signals, and the hardware and software used to amplify, process, and transduce those signals so that they may be heard and felt, involves a sustained act of care for discourse surrounding their ontology, epistemology, ethics, and æsthetics. In this practice of critical appropriation, questions about what an ECG is and how it works are inseparable from questions about what the heart is and why we might want to measure it. Questions about how to relate to a sonified ECG signal in a musical context are inseparable from questions about how we conceive of musical time, and other temporalities. Practical questions concerned with how to properly wear an ECG and the effects of movement on the signal are inseparable from questions of physiological control, the relationship of space to time in dance, and the ways in which space and time are constructed. The goal here is to gain insight into our practices as they are disrupted at the point of their intersection with an object of incommensurate difference.

There is always risk that the transposition of specialized technology across disciplinary lines will compromise the rigour and scepticism of the respective disciplines. For example, in the appropriation of biosensors from medicine to artistic practice, diagnostic practice may be diminished, because artists have different disciplinary training, and divergent (non-medical) goals. Likewise, the rigour of compositional and choreographic practices may be undermined by the

imitation of foreign techniques for research, which serve the intentions of an alternate discipline. Importantly, an artist employing a biosensor in a manner contrary to the training of a medical professional should not be seen as lacking that training any more than a nurse who uses a biosensor without considering the aesthetic implications of their actions should be seen as lacking artistic integrity. In scenarios of appropriation, the question is not whether the encountered value systems are good or bad or right or wrong, but rather, what goals these values propagate in a given disciplinarily-constituted, and therefore exclusive, context.

For example, consider the heart that continues to beat in your hands. It is incommensurable with the trace of an ECG. The ECG measures an aspect of the heart that we do not feel when we hold it in our hands. They are related and in relation, to be sure, but the ECG is not “the-thing-we-call-the-heart,” i.e. the seat of the soul, the originary source of music and love. The sensation of your heart pulsing in my hands is of an order of complexity that defies description in terms of dimensionality, space, and time. These beats that I feel are simultaneously neither-discrete-nor-continuous-yet-both-discrete-and-continuous (Maffie 2004, n.p.). They travel through and between both of my hands, which, as I slowly move them, continue to shift the origins and trajectories of discrete-continuous pulses. I placed my hands inside your chest because I wanted to be closer to you, to experience your heart directly, free from the noise of mediated experience. I wanted to hear, feel, see, and smell your heart, not your chest, your lungs, your skin, your electrical potential. But I am still on the outside, around your heart. I don’t think I wanted to be *inside* your heart; I think I wanted to be coextensive with it.

Noise is a problem with all acts of measurement, but here, perhaps, “noise” can offer opportunities to explore what Guattari might call the “mutant coordinates” of a discipline. The pill that we are offering here is a hard one to swallow: we are suggesting that noise, the very “thing” that obfuscates the “thing” we are interested in, should be considered as an opportunity to question the foundations of our interest in that particular “thing”; that the noise that prevents us from recognizing a particular “thing” as an object of interest for interaction (be it a physiological process, a gesture, or a body) might be an indication that our notions of the constitutive boundaries of this “thing,” are, in fact, noisy.

By paying attention to the noise of our own perception, which may be based on our disciplinary training and cultural context, as well as our material bodies and material practices, or our mood on a given day, we become implicated as subjects in the perceptual process. Likewise, by paying attention to the noise produced by the hardware and software, its designers and users, and the intra-active context of interaction, the exclusion of data from a signal, becomes evident. Importantly, there is no un-noisy or un-mediated signal, nor is there an un-noisy or un-mediated perception of this noisy signal. Noise is always present, and in cases of appropriation of technologies, interrogating so-called noise can point towards the operation of ethics within and between collaborators and disciplines.

What is at stake here is the construction of a discipline that no longer recognizes that there are conceptions of gestures, bodies, processes, or concepts, outside of its frame. Once we as a

community have decided, implicitly or explicitly, what, for example, a gesture is, we can stop looking for gestures that fall outside of that spatio-temporal frame. The reorientation of the concept of gesture from descriptive to prescriptive brings with it an ethical weight that can stagnate a discipline through the subjugation of aesthetic exploration. That bears repeating: the moment that we make the transition from using the concept of gesture to describe aspects of a mover's movement, to prescribing that movement as a gesture, we have entered into ethical territory that begins to restrict aesthetic choice. This process of restriction is inescapable; our goal here is not to advocate for its dissolution, but rather for a continual process of disruption of ethical restrictions through critical appropriation, disciplinary collaboration and aesthetic exploration. Through the intersection of divergent value systems in disciplinary crossings, there is potential for disruption of the calcified conventions of each discipline—by all that haunts them—and therefore a reconfiguration of what is being included and excluded from their respective territories.

Guattari likens this type of destabilization to mutation and sees the reframing of disciplinary structures such as psychoanalysis in terms of ethico-aesthetics, rather than simply ethics, as key to resisting stagnation and homogenization.

If we turn for a moment to a discipline like psychoanalysis, which claimed to affirm itself as scientific, it is increasingly clear that it has everything to gain from putting itself under the ægis of this new type of aesthetic processual paradigm. Only in this way can it reacquire the creativity of its wild years at the turn of the century. (Guattari 1995, 106)

In the field of psychoanalysis, this has deep implications that require no less than the redefinition of the body itself.

Let us take as a final example an open redefinition of the body, so necessary for the promotion of therapeutic assemblages of psychosis: the body conceived as intersection of partial autopoietic components, with multiple and changing configurations, working collectively as well as individually; all "the bodies"—the specular body, the fantasmatic body, the neurological corporeal schema, the biological and organic soma, the immune self, the personological identity within familial and environmental eco-systems, collective faciality, refrains (mythical, religious, ideological...). (Guattari 1995, 117–118)

This passage is remarkable in its articulation of an aspect of psychotherapy, a predefined conception of the body and its binary relationship to the brain, that for many practitioners has been rendered invisible by the boundaries of their disciplinary training. Further, it points to the difficulty of the type of work we propose in this paper, which is to say, we are advocating for engagements with technology that are harder, not easier, slower, not faster, and which not only defy measurement and evaluation, but call into question the nature of their roles.

Our formulation of critical appropriation thus far has been with respect to the use of technology for purposes other than those for which it was designed. Critical appropriation, however, is a general, diffractive practice intended to bring awareness to, and care for, the multiplicity of an

object and to prevent its collapse down to something perceived as singular by the practitioners operating inside the structure of an emerging discipline. We appropriate technologies critically as an intervention intended to destabilize the boundaries of our practice, but it is normal for new practices to emerge out of those interventions. As practices stabilize, they become technologies in the world, belonging to others than ourselves, until ultimately that which we engendered, we now appropriate, critically.

Critical appropriation is a destabilizing practice—a process of intervening in moments of relative comfort in order to interrogate aspects of practice that have stabilized and receded into the shadows. From the shadows, these elements continue to calcify into increasingly solid boundaries making voices that come from outside their borders increasingly less intelligible. These boundaries form the ethics of a discipline—they separate those actions that cannot be done from those that must. They produce language that renders utterances unintelligible and construct the machinery that allows actions to be seen as transgressions. To repeat more generally, what is at stake here is the construction of disciplines that can no longer recognize forms of knowledge and know-how that operate outside of, yet continually haunt their boundaries.

Release the air in your lungs as you gently release the heart in your hands. Bring awareness to the rising and falling of your pulse as you breathe deeply and slowly, in through the nose, out through the mouth. Find a position that's comfortable as you recover your breath.

POSTLUDE: APOLOGIA

Wherever you are, imagine you are us, and there are three people sharing the space with you: Karen Barad, Michel Foucault, and Félix Guattari. They are seated or standing, silent, relaxed, simply listening and observing. You, choreographer-composer, in making a point to yourself, composer-choreographer, reach for a text you did not write, wielding it as a weapon of debate, subject to the gaze of the person who wrote it and their peers.

Appropriation is always violent, and we have engaged in it throughout this paper; for that we apologize, especially to those from whom we have taken and mis-re-presented. Appropriation is not ok and cannot be made ok by acknowledging or apologizing; the only thing we can do is act responsibly inside of the context of our own making. The words in this paper are ours, even those we attribute to other authors—and now they are yours.

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Biographies

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