2022-06

Cyborg Reading: Transmedial Digital Poetry and the Cyborg Milieu

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Cyborg Reading: Transmedial Digital Poetry and the Cyborg Milieu

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE

DEGREE OF MASTER OF ARTS

GRADUATE PROGRAM IN ENGLISH

CALGARY, ALBERTA

JUNE, 2022

Abstract

This study gives an overview of digital poetry as a transmedial creative practice calling for a transdisciplinary approach to literary criticism. It covers a range of digital compositional tools, from text generation and 3D printing to virtual and extended reality techniques, from the perspective of a critical posthumanism informed by cyberfeminist reading practices. The study consists of three parts and combines analytical strategies from several research methodologies—including autobiographical literary criticism, critical code studies, media-specific analysis, and research-creation—into a hybridized literary criticism responsive to the parameters of the poem at hand. The first chapter addresses poetry produced or consumed with a computer, arguing that computer mediation fundamentally alters the relationships between readers, writers, and literary texts. The second chapter takes up the influence of materiality on readers' apprehension and interpretation of digital poetry and demonstrates the significance of features falling outside the domain of conventional literary criticism, like source code and interface design. The final chapter situates digital poetry in a wider cybernetic milieu that encourages readers to look beyond the poem as a singular artifact or experience. These arguments support my conclusion that reading critically ought to be treated as a modular, transdisciplinary practice. Cyborg reading fosters digital transliteracy: a confluence of reading, writing, and social skills necessary in an increasingly participatory culture. The ability to recognize and interpret meaning across a range of media and disciplines is of high value in an ever-changing and multivalent media ecology. By putting autobiography into dialogue with close readings of digital poetry and the discourse surrounding it, I position transliteracy, not as a revolution in literary criticism or a call to reform academic institutions, but as a form of literacy already incumbent on contemporary readers and writers.

Preface

This thesis is original, unpublished, independent work by the author, K. Flemmer.

Acknowledgements

This study is made possible by the generous support of many people at the University of Calgary and beyond. It takes a community to produce thoughtful research, and I extend my sincere thanks to all those who offered guidance, encouragement, critique, and respite during my studies, especially the following people:

To my supervisor, Dr. Michael Ullyot, thank you for your insight, enthusiasm, attention to detail, and belief in my vision. You allowed me a lot of autonomy while providing all the necessary course corrections, and I'm grateful for your direction in shaping this work.

To Marlee and my family, thank you for making space for me to explore my interests. You always have, and knowing you are behind me feels like having a superpower. Love you all!

Thank you to the Faculty of Graduate Studies, the Department of English, and the Social Sciences and Humanities Research Council for financial assistance in support of this research.

To my defense committee, Dr. Anthony Camara and Dr. John Aycock, thank you for your valuable time and expertise. Thanks also to Dr. Stefania Forlini, Dr. Jaqueline Jenkins, Lorans Alabood, and Jeremiah Baker for enriching my studies.

And finally, to my friends and colleagues: Amy LeBlanc, Aaron Tucker, Eric Schmaltz, Dani Spinosa, Ben Robinson, Marc Herman Lynch, Cristalle Smith, Ryan Stearne, Ramsey Hedayat, and derek beaulieu. So much of this is your doing, quite literally. You're an inspirational bunch; thank you for being exceptional human beings.

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Introduction

Have you ever held a poem? By that, I don't mean a book of poetry, but a poem itself, cupped like a stone in the palm of your hand? I held my first poem in 2018 at the Digital Humanities Summer Institute (DHSI) conference in Victoria, BC, a 3D-printed poem by Aaron Tucker, Jordan Scott, and others. This object poem is part of a project called *Loss Sets* that turns text into printable objects by converting its letters into numbers, grouping these numbers into coordinates, then modeling the coordinates in three-dimensional space (see figure 1). The resulting object poem is a cubic sculpture rendered in plastic, little more than an inch to a side, with irregular geometric crevices. Its surface is lined with tiny ridges where the printer laid down each layer of material, and it reminds me of the Borg cube from *Star Trek: The Next Generation*. I was dazzled by the novelty of this object—a poem transformed by a computer into something I could touch—and surrendered it jealously when my turn was through.

A few days later, in the archive at the University of Victoria, I found myself holding a three-thousand-year-old clay tablet, *The Cuneiform Tablet of Amar-Suen*, its age-worn surface crisscrossed with writing in Sumerian cuneiform (see figure 2). The tablet is about the size of a charcoal briquette and documents the issuance of copper tools. It's a little larger and noticeably heavier than the 3D-printed poem, though its intricate surface markings immediately recalled to my mind the irregular geometry of *Loss Sets*. How utterly different, these two material instances of language, and how bizarrely similar the experience of interacting with them. Both are inscribed in languages illegible to me, yet they convey meaning nonetheless (though perhaps not exactly as encoded by their authors). It took only a few moments of physical contact with these objects to reorient my relationship to language, each artifact becoming emblematic, not of the extremes of writing, but of what writing is and has always been: matter made to signify.

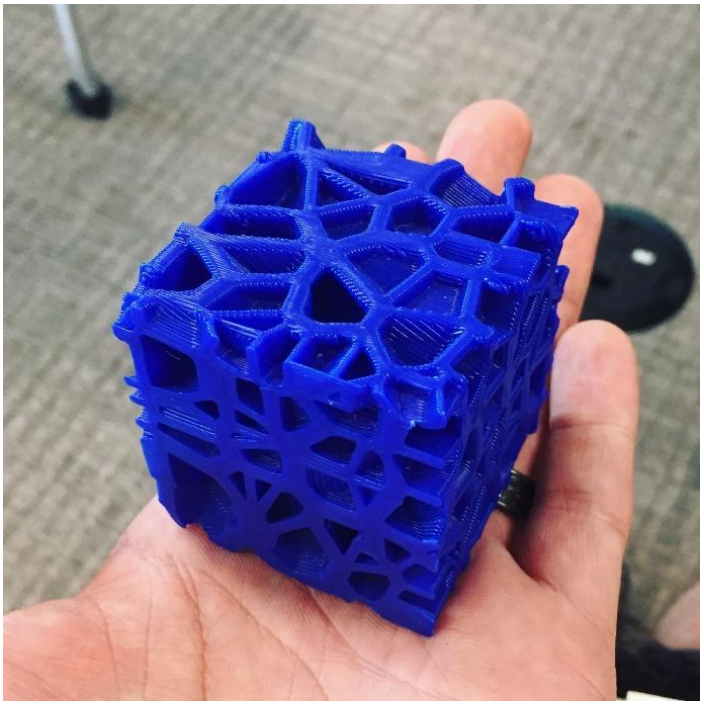

Figure 1. “Loss Set 2” from *Loss Sets*, 3D-printed object (Tucker et al.).

Figure 2. *The Cuneiform Tablet of Amar-Suen*, clay tablet. Photos by K. Flemmer.

My love of books and the materials of language long predated my trip to DHSI, but the experience opened me to the perception of all writing as appealing to the human sensorium by way of materials, whether carved in stone, pressed into paper, or displayed on screen. I regard poetry as a subtype of literature which treats language itself as a creative medium, often drawing attention to the sensory experience of words as meaningful independent of their semantic content. Poetic language use is both sensual and procedural, bodily and conceptual. Especially fascinating to me are the reciprocal relationships forged between poetic form and content: for instance, how structural decisions play out at the level of word choice. I am not sure if any one definition of poetry is capacious enough to encompass all the ways I have come to think about it, but my reasons for loving and writing about poetry are common among poets and critics, so I won't belabor the question of why to study poetry. Suffice it to say, poetry lends itself well to the sustained observance of the materials of language.

Though not poetry, *The Cuneiform Tablet of Amar-Suen* conveys its message by way of a physical presence communicated directly to the body, just as *Loss Sets* does. The method of searching these objects for meaning—forming impressions and interpretations, connecting sense with experience, inviting memories and imagination, making judgements—is essentially the same. However, human hands only crafted the former; the latter's co-authors place several layers of communications technology between themselves and their readers. I left DHSI with a burning question: where do computers fit in? How do they factor into meaning-making as a human interpretive process? Unlike writing in a physical medium, writing in a digital medium requires other, non-human languages: specifically, machine languages. The translation of every operation into binary necessitates layers of code, a multiplicity of texts behind each word visible to human readers. Tucker spoke to this curious principle of digital literature during the presentation he gave

at the conference where I held his poem.[1] Built atop a hierarchy of machine languages, *Loss Sets* contains many more texts than just the human-authored poem it purports to represent; it also contains the binary, assembly code, vector coordinates, and printer instructions necessary to manifest the poem in three dimensions. Which, then, is the definitive version of *Loss Sets*: the original text, the vector model, the code, or the printed object? None of these answers are satisfactory on their own. *Loss Sets* is nebulous, manifold, existing in several interlinked media at once.

As predicted by Marshall McLuhan over fifty years ago, the involvement of computers in the production and consumption of media has profoundly reformed our relationship to creative content of all kinds, not only in the way we receive and interpret messages, but in how each message relates to the wider world through which it circulates. McLuhan writes in *Understanding Media* that, "[i]n the electric age, when our central nervous system is technologically extended to involve us in the whole of mankind and to incorporate the whole of mankind in us, we necessarily participate, in depth, in the consequences of our every action" (20). So, too, in the consequences of our every expression. The electrification of literature, already an interconnected, intertextual medium, has led to an astounding variety of hybrid creative forms and practices: a provocative situation, to be sure, though aspects of these new modalities fall outside the purview of pre-digital literary criticism. Poet and scholar Dani Spinosa provides several reasons why analytical methods rooted in print traditions might be considered insufficient for electronic literature (e-lit for short):

[1] Tucker's 'lunchtime talk' presentation, "A Humanities Application of 3D Printing and Machine Translation in the *ChessBard* and *Loss Sets*," was offered on 7 June 2018 during DHSI at the University of Victoria. We have since become friends and collaborators; I even published *O/Ô*, a visual poetry project of his covered in Part 1, "Boundary Blur." Tucker's support has been invaluable in pursuing this research.

> Many of the individuals involved in the production of e-lit identify themselves not as authors but as artists, graphic designers, engineers, programmers, project directors, librarians and archivists, and so on. The production of e-lit frequently involves collaboration with nonhuman entities such as programs, search engines, text generators, or source code. E-lit is also often made from human collaboration, especially internationally, and frequently results in self-publication online or in online journals. ("Toward a Theory of Canadian Digital Poetics" 239)

Digital poetry presents a host of challenges to received notions about authorship, writing implements, publication models, and reader agency, among other things. It evolves in response to changes in our literary medium, materials, and milieu.

Take, by way of analogy, the vast differences between traditional print journalism and the 24-hour news cycle ushered in by network television and accelerated by social media. The same news item circulates very differently in print than it does online; for one, the online version likely has a comments section where readers can respond to the article, and, for another, it can be shared at the click of a button, giving journalists access to a distributed readership simply unreachable through print. I encounter these differences regularly in my capacities as an author, editor, and publisher of experimental poetry, a loose genre of poetry oftentimes testing the limits of form and medium. The sharp contrast between publishing in print and online can be frustrating—printing in color, for instance, is prohibitively expensive, whereas it makes no difference online—but this contrast also reveals productive tensions and the lines of inquiry poets explore between digital and analog media, as we shall see in Part 1, when we turn to the transmedial digital poem *The Sims in Real Life* by Ben Robinson.

I had the pleasure of publishing *The Sims in Real Life* in 2019 through my small press, The Blasted Tree Publishing Co., and I should admit right off the bat that I have personal investments in many of the projects, poets, and critics I cover here. I argue that my personal and professional connections to these authors and their work puts me in a unique position to conduct research on them. Moreover, the identity of the critic, who in most cases is also a poet, plays an important role in digital literary scholarship, as is regularly made explicit at the outset of analytical work.[2] Nick Montfort self-identifies as a poet in his critical work, and his directness is refreshing: "Since I am a creator of digital poetry, interactive fiction, and other computational literary works, I discuss the work I have done alongside other work that I approach critically" ("Computational Literature" 207). Montfort is a prominent figure in the field of digital poetics and, like several of the scholars I address,[3] can't help but write from his position in the middle of things. I am reassured by Montfort's justification of and reference to others pursuing an openly personal methodology as I am eager to discuss a handful of projects published by my own small press, an approach that is, Montfort asserts, "particularly appropriate in a field of emerging practices" ("Computational Literature" 207).

An important predicate of my research is that materiality informs critical methods—i.e., those brought to bear on pre-digital texts—and I am indebted to literary theories and methodologies that prefigure or buttress the "material turn" in digital literary criticism (Munster, "Materiality"). These include: New Historicism, which collapses distinctions between text and context; Presentism, accounting also for the critic's context; Postmodernism, which promotes intertextuality, pluralist readings, and the disruption of the author's centrality; and, most notably,

[2] In fact, nearly every critic I cover makes an autobiographical statement of some sort. See Borsuk's *The Book* (xii), Naji's *Digital Poetry* (1), and Tucker's "Machine Co-Authorship(s) via Translative Creative Writing" (1–2).

[3] Hayles and Flores, for instance, have each served as President of the Electronic Literature Organization.

New Materialism, a posthumanist adaptation of historical Materialism that interrogates "the prominence given to language, culture, and representation, which has come at the expense of exploring material and somatic realities," all without losing sight of social concerns like political ideologies and power relations (Sencindiver). New Materialism is a relatively recent and heterogeneous critical theory infused with feminist, postcolonial, and posthumanist perspectives, so it is well suited to critique a literature as diverse and amorphous as digital poetry. Though digital media is in many ways dramatically different from its analog precursors, digital media theory does not necessarily represent a sharp discontinuity with prior modes of interpretation. The posthumanist and cyberfeminist frameworks on which I rely are themselves indebted to critical theories developed in pre-digital contexts, and so I advocate for a style of research that incorporates new methodologies alongside established ones.

This study—incorporating the foundational theories outlined above—unpacks the effects on literary criticism of a widespread digitalism as it intersects with materiality, and is therefore framed by my personal experiences as reader, writer, editor, and publisher of digital poetry. To focus the endeavor, I have sought to address three central research questions, corresponding to the three parts of this study:

1. Does digitalism really alter everything it touches, as McLuhan suggests, and, if so, how has it revolutionized the object of literary criticism? This admittedly loaded question can be approached by raising a related and perhaps simpler one: what is digital poetry?
2. What new analytical techniques or frameworks might be brought to bear on the evolving materials of digital poetry? Again, this guiding question can be approximated by way of another: what is digital materiality?

3. How does the digital milieu affect the creation, circulation, and interpretation of poetry? Are there reading methods particularly suited to digital media environments, and, if so, might they be used for literary critique? This last question follows upon the others and is intended to ground my research in the context of its production and reception: i.e., in the academy itself. In the broadest terms possible, I am asking after the skills and circumstances needed to read digital poetry critically.

My approach to this subject is largely inspired by the work of three very different authors, beginning with Alice Major's *Intersecting Sets*. Major examines the overlap of science and poetry, providing a model for my own work in two respects. She treats highly technical subject matter from both literary and scientific fields in such a way as to make it accessible to a non-specialist readership, carefully and judiciously paraphrasing technical materials, or using analogy where suitable. Given that Major's project brings together fields conventionally regarded as separate, as does my own, she acknowledges that specialists in a field may not have much knowledge outside of it. Moreover, Major affects a union of disciplines by way of autobiography, using personal narrative to thread together the various scientific and literary topics covered in *Intersecting Sets*. By introducing her subjects through personal anecdotes, Major transmits to readers her excitement and wonder at discovering these connections, as though we're learning of them alongside her. This clever narrative and didactic structure guides readers through technical information, making seemingly impenetrable subject matter (of either scientific or literary origin) more approachable to a non-specialist audience.

If Major inspired the tone and style of my project, then Donna Haraway's "A Cyborg Manifesto" inspired the subject. Haraway is in many ways an oblique but necessary grounding for

my work. Though she eschews the term posthumanism, her brand of posthuman-adjacent feminism is the critical theory prompting my return to a childhood fascination with digital media from a position of general skepticism about technology adopted as an adult. Social and environmental crises caused by the reckless or misguided pursuit of 'progress' have become increasingly frequent and severe, and my attitude toward emergent technologies has been jaded over time. And yet, Haraway's pragmatic optimism about the co-creative enterprise of living in a world intertwined with technology—as embodied by the figure of the cyborg—persuades me away from a myopic view of technology as a perilous trap. "*Sympoeisis*," Haraway writes, "is a simple word; it means 'making-with.' Nothing makes itself; nothing is really autopoetic or self-organizing. […] *Sympoeisis* is a word proper to complex, dynamic, responsive, situated, historical systems" (*Staying with the Trouble* 58, emphasis Haraway's). This is a position Haraway develops over the course of her career and is, in part, a shoring up of the oversights of "A Cyborg Manifesto."[4] Though cyborgs remain powerful figurations for thinking through human-computer relationships, I argue that digital poetry also fits the description of a sympoetic system quite nicely. Moreover, through Haraway's lens of posthuman-adjacent feminism, digital poetry can be read as an embodied cultural response to our techno-dystopian present, a topic I expand on in Part 3.

Haraway's scholarly work is characteristically intimate, attributive, and non-hierarchical, an approach I have come to think of as the foundation of cyberfeminist discourse, and one I've sought to cultivate in my own work. She is exacting and humble in acknowledging her influences, quick to praise exemplary efforts, liberal with personal anecdotes, and eager to distribute authority. She writes about others as friends and peers, as real people outside their utility to her argument.

[4] Haraway adapts M. Beth Dempster's conception of sympoesis to counteract the emphasis that second-order cybernetics places on autopoetic systems, i.e. self-making systems which reflexively integrate and adapt to feedback about their own processes. Haraway pushes back against this idea of self-producing, autonomous, rule-based units in favor of collectively-produced, unbounded, unpredictable systems. See Haraway, *Staying with the Trouble* 33.

Cyberfeminism attends to cybernetic communities as Haraway's feminism attends to sympoetic ones. Appropriating the figure of the cyborg for literary criticism is justified, in my opinion, by Sam Cutting, who argues for the usefulness of Haraway's cyborg in thinking through transmedial literature. Cyborg thinking, Cutting writes, rejects "claims for the ethical singularity of the literary text," demanding that critics abandon their aim to "resolve" the "ambiguities and affinities" of literature, and instead endeavor to "cherish" ethical undecidability. This call echoes that of postmodernism, though a historically situated cyborg figure adds at least two subtleties to postmodernist critique: first, that reading and writing are forms of cyberfeminist practice emphasizing the sociohistorical and intersectional dynamics at play in literary texts; and second, that any engagement with technology by an individual is a deeply social activity. This suits me fine, as I write openly about my connections to the authors and literary works I study. To summarize the ethics of cyberfeminist discourse, a line from "A Cyborg Manifesto" that draws together several of the above-mentioned concerns and offers some advice: "The cyborg is a kind of disassembled and reassembled, postmodern collective and personal self. This is the self feminists must code," and it is the self I hope to encode in my own scholarship (33).

The third and final broad inspiration for my work is that of media theorist N. Katherine Hayles. I came to Hayles relatively late in the game, somewhat after starting research on this project, but her writings have added vital methodological elements and helped shape my arguments about digital text. I quickly found parallels between her thinking and my own, particularly on the subject of analog versus digital technologies of inscription, so much so that her work feels remarkably monolithic and immediate, as if I've turned around to find her towering over me. This isn't to say we agree about everything, or even that she's the critic my writing most closely emulates, but to acknowledge a previously unknown inheritance almost spooky in its genetic

similarities. *Writing Machines* in particular inspires my present work. In addition to Hayles' insightful analysis of digital poetry, the book includes a highly personal meditation on a career spent doing digital literary criticism in a field dominated by print bibliophilism. To accomplish this, she constructs a third-person avatar, Kaye, to mediate between Hayles-the-author and her readers during the autobiographical segments, a sophisticated, if unconventional, rhetorical foregrounding of memoir as a research method for media criticism. Her construction of the Kaye persona is deliberate and overt; as Hayles-the-narrator points out, part of the project of "[t]elling a fuller story"—i.e., of pushing literary discourse beyond its focus on print culture—necessarily involves "interrogating the author's position" (*Writing Machines* 9). For Hayles, this means asking how her own background and experiences have led her to formulate the conclusions laid out in *Writing Machines*. When and why she formed her central ideas figures into the presentation of those ideas, and when she turns to her case studies, I have the distinct impression she speaks from a viewpoint that is consciously subjective.

Hayles makes good use of autobiography as a framework for her brand of literary analysis, and especially for the interpretive method she terms media-specific analysis. In short, media-specific analysis is "a kind of criticism that pays attention to the material apparatus producing the literary work as physical artifact" (*Writing Machines* 25). This method is informed by hands-on experience with digital poetry, which is to say with a human-computer interface of some sort. Interpretation is therefore rooted in sensory perception, itself embedded in and filtered through personal and sociohistorical contexts. The experiential nature of engagement with literary artifacts inevitably leads to a plurality of interpretations, each resulting from the unique circumstances of the mind-body-machine relationship acting at their intersection. I take up the human-computer relationship as it is expressed through literature in Part 1 of this study. Fortunately, most critics of

digital poetry do not regard multiple interpretations as an obstacle to scholarly rigor, rather the opposite. Spinosa, for instance, advanced a form of postanarchist literary theory that advocates for a high degree of reader agency. In *Anarchists in the Academy,* Spinosa emphasizes the impact of using digital compositional tools, the transmedial status of digital literature, and poetry as it is actually navigated by readers. My method has incorporated aspects of both media-specific analysis and postanarchist literary theory for the very reasons that Spinosa advocates for free readership: to highlight the critical roles of interaction and interpretation in the lifecycle of all literature, and to return our attention to the real-world conditions of that lifecycle.

The material conditions of digital poetry, and literary materials themselves, are the primary focus of Part 2. Building on a twofold understanding of digital materiality,[5] I cover a range of digital parameters literary critics have considered material. As you might expect, the mediation of human language by machine language significantly complicates our understanding of what physically constitutes a literary text. In analyzing digital literary artifacts, it may become necessary to look at the code behind it, and the hardware running that, to access every signifying aspect of the work. This can lead out of the field circumscribed by pre-digital literary criticism and into other disciplines—computer science, for example—a problem only insofar as boundary distinctions discourage active engagement with every feature of a digital text. Fortunately, transdisciplinary approaches are evolving on both sides of the humanities/STEM divide. Mark C. Marino encourages computer scientists to conduct what he calls critical code studies, or "the methods and the scholarship […] involved in the analysis of the extrafunctional significance of source code," i.e., the study of meaning beyond the operations of code itself (18). Marino argues that, because

[5] I elaborate on the important distinction between the physicality of digital objects and the material conditions of their production in Part 2. See also Munster, "Materiality."

computer code often circulates and is read more widely than in its strictly executable sense, code can and does accumulate significance in a variety of contexts: personal, historical, social, and perhaps also literary. I suspect this argument works both ways, and that critical attention to the technical parameters of a digital poem entails looking beyond the text to its hardware, software, and sometimes even its source code.

Following Hayles' media-specific analysis, I have tailored a method for this study I term composite analysis. Generally speaking, a composite is made up of two or more materials with differing but complementary properties. I conceive of transdisciplinary studies as a sort of meta-methodology wherein discrete methodologies are combined to formulate specialized analytical frameworks responding to specific objects of study. The term composite recalls Haraway's cyborg figure and cyberfeminist discourse, and so composite analysis must ground the details of a particular work in its sympoetic network. Part 3 of this study examines the differentially-networked milieu of digital poetry, including the hybridization of virtual and physical spaces in extended reality (XR) poetry. I say 'differentially' because, despite the assumptions of some media theorists, universal access to network infrastructure remains a utopian fantasy. Rather than indulge such fantasies, composite analysis remains a political methodology colored by its sociopolitical context, namely, the exploitative extraction, manufacture, and military industries at the heart of technocapitalism. As David Cecchetto puts it, "digital artists owe a political debt that must be in some way balance[d] by their artistic output" (23). Settling this debt is the bare minimum we might expect of digital artists, particularly in creative practices with an overtly political framing. Scholars engaged in digital literary criticism must also take sociopolitical dynamics into account, both in their own work and in that which they study. For my purposes, it is fair to raise questions about, for instance, the ethics of using plastic as a material for ecopoems, as in Tucker's *Loss Sets*, or of

using Meta's *Quest App Lab* platform to distribute open access XR poems, as in "Phases of the Moon" by Simon Theis Hansen.

If cyborg literatures transgress against orthodoxies of formal discipline, especially when thinking beyond materials in a strictly combinatorial sense, then we do well to ask what other norms a digital poem might break. Marcin Ramocki argues that hacking should be considered a subversive creative practice: hacking meant both in the immediate sense of modifying, repurposing, or otherwise misusing specific technologies, and in the broader sense of inventors and pioneers revolutionizing cultural paradigms and value systems. Ramocki makes a case in "DIY: The Militant Embrace of Technology" for developing a range of technical proficiencies by engaging in do-it-yourself, homebrew, artistic hacktivism, and I've found these strategies indispensable for conducting research in digital environments as well.[6] It is therefore worthwhile asking if and how digital poetry attempts to hack, disrupt, or subvert the systems in which it participates. If poets make use of shortcuts, backdoors, piracy, cracks, or hacks, it is advantageous for readers of digital poetry to be fluent in these techniques; a full and fair analysis may depend upon their recognition of the rules bent or broken in the creative process.

Noticing where something is broken is as important as knowing when and why it works, as anyone with experience debugging code will tell you. Unfortunately, the McLuhanian belief that a digital revolution signals the free and universal circulation of information tends to gloss over the real world limitations of the systems on which this ideal is built. The charge of idealism might also be levied against posthumanism, which stands accused of wishing to transcend that which makes us human: morality, mortality, and so on. Tucker suggests evaluating digital literature

[6] For example, reading a PDF in lieu of a hard-to-find book, running outdated software on an emulator, and recording my screen as a form of research documentation.

through a lens Rosi Braddotti refers to as critical posthumanism, a position that resists individual-focused and Euro-centric humanism in favor of "an enlarged sense of inter-connection between self and others, including the non-human or 'earth' others" ("Machine Co-Authorships" 7). Tucker's own writing practice emphasizes "communal acts across species, and asks that the writer and the reader examine how their own bodies, virtual and physical, play into the different aspects of a work" ("Machine Co-Authorships" 7). Interconnection, kinship, and deference to non-human agency: these qualities of the cyberfeminist ethic inoculate posthumanism against transcendent aspirations, re-embedding posthuman thinking in real-world political and material circumstances.

Critical posthumanism is not only a critical theory, but also a critiqued theory, one that is capable of internalizing and adapting to criticism of itself. One criticism I would make of posthumanism is of the prefix post-, which implies a temporal distinction between some prior conceptual purity of the human and whatever it is we have become instead. I prefer the prefix trans-, as in transhumanism, meaning beyond or changing, the implication being that humanity as a concept is continually modified and supplanted. However, the term transhumanism already carries its own connotations and refers to an assortment of theories with which I do not align, and so, even though I dislike it, I stick to the term posthumanism throughout this study as it reflects the more accurate field of thought. I should also remark on my preference for the term transdisciplinary over multi- or interdisciplinary with respect to digital poetry. In my view, multidisciplinarity involves cooperation between two or more separate disciplines, while interdisciplinarity connotes a place between disciplines where practitioners and techniques are integrated into a new and cohesive whole that doesn't belong to any discipline in particular. Transdisciplinarity goes even further by making claims against the boundaries between disciplines. Transdisciplinary work is situated on a multidimensional spectrum of disciplines, partaking in

many while resisting its expulsion from any of them. From this perspective, digital poetry can be read as an expression of a posthuman culture that is itself already transmedial and transdisciplinary.

Research in this field has rewired my understanding of literary studies, and I put forward three interconnected theses in response to my main research questions. First, I argue that digitalism has exploded conventional assumptions about literature by defying formal boundaries to produce transmedial literary artifacts. Second, transmedial poems exhibit a variety of material and conceptual characteristics relevant to their interpretation which fall outside the purview of conventional literary criticism. Third, and developing from these first two points, I argue that digital poetry is embedded in a network of material and conceptual concerns that link a poem to the milieu through which it circulates. Even taking my conclusions for granted, we might still ask: why does this research matter? Through attention to digital poetry, I have come to believe that the main competency developed in transdisciplinary studies—transliteracy, or the ability to recognize and interpret meaning across a range of media and disciplines—is crucial for navigating an ever-changing and multivalent media environment. Transliteracy is also valuable for thinking critically about the impact of a medium on its message, as stipulated by McLuhan's oft-repeated maxim, and is therefore of special significance in an increasingly transmedial world.

Part 1 – Computer Mediation

Dad brought home our family's first desktop computer when I was eight years old, a Power Macintosh tethered securely in my childhood memories to a monolithic off-white monitor displaying the Apple logo jigsaw puzzle game. My dad remembers the computer as expensive junk nobody in the family made good use of; I remember putting that puzzle together dozens of times before losing interest in the computer altogether. The first hurdle between me and this machine was that the Macintosh interface was totally unlike the DOS-based IBM computer in my classroom at elementary school. Worse still, the few games we had for it were bare-bones and sluggish, not at all comparable with those I played on the Super Nintendo console hooked up to our TV. As for the classroom computer, this ancient contraption accepted massive floppy disks and displayed all-green text on its monitor. We used it sometimes for spelling and typing exercises, but mostly it sat dormant in the back of the room. And so, sadly, I cannot profess a deep love for computers ever since the earliest days of my exposure to them.

Over the next few years, as home computers became more and more common, they grew increasingly important in my social life, especially with the rise of online instant-messaging services. The family battle for the home telephone became a battle for the dialup line, and I would often stay awake long into the night trading messages with friends from school. Our household switched to a Windows-operated machine with a wider selection of software—including some excellent video games I still play on occasion—and soon the computer became a tool I used almost daily, so much so that when we got a second computer and I claimed it for myself, no one in the family complained. Having a computer of my own triggered a major shift in my understanding of their value. At first I assumed computers were similar to television, with a handful of ready-made

programs like TV channels. It wasn't until I began customizing a computer to suit my personal needs that I started to appreciate their potential to facilitate a seemingly infinite range of activities.

The other major shift in my relationship to computers came in junior high with an introduction to the school computer lab, a resource which quickly became a mainstay in my education from that point forward. Entire classrooms could now work on computers together, opening up a host of new methods for accessing course materials, conducting research, and preparing assignments. I learned how to write an academic essay, much like this one, not in a school library with books, paper, and a pen in hand, but in a computer lab with Netscape Navigator and Microsoft Word open in front of me. Eventually, almost every assignment for my core classes involved a computer at some point in its development. My interest in creative computing skills gained momentum, and I started taking every computer-based option available at school. In junior high I learned how to code HTML, make GIF animations, and use HyperCard on an egg-shaped iMac G3. In high school I added Turbo Pascal, 3D Studio MAX, and Adobe's suite of art and design software to my technical repertoire. On top of all that, I attended summer camps at the university to experiment with C++ and Macromedia Flash. While this litany only touches on the ways I found to tinker in school computer labs, it shows how deeply integrated they became in my life, particularly insofar as they provided opportunities for creativity.

These experiences viewed in retrospect are somewhat curious in that almost every bit of hardware and software mentioned above has by now been completely revamped, if not totally outmoded. Macromedia Flash, for example, was acquired by Adobe in 2005, under whose stewardship it underwent not only its broadest usage, but also its eventual end-of-life. Though technologies change, I find that proficiencies in one coding language or application are nonetheless transferable. Since 2014, I have operated a small press that publishes both in print and online,

primarily visual poetry, and this requires a constant weighing of the pros and cons of digital and analog formats. While I no longer code in HTML, learning the fundamentals of website design when I was young has proven invaluable for managing the challenges of formatting visual poetry for publication online. The inverse is also true; learning to work with Adobe InDesign in high school now helps me to realize transmedial projects in print. Conversations about negotiating digital and print formats are being had everywhere in the publishing world, though there is a curious lack of discussion about how different formats influence the reading experience.

The first time I encountered any real attention to how computers might alter our experience of literary texts was at Tucker's lunchtime talk at DHSI in 2018, where he made explicit the layers of machine language mediating between human readers, writers, publishers, and scholars interacting with text in a digital environment. Tucker's overview of the nested operation of machine language, from high-level programming languages all the way down to binary and back, planted a seed which has become the first main research question of this study: given the widespread adoption of personal computers, how has the study of literature changed? What happens to poetry when it is mediated by machine language? I am not the first to raise these questions, and their answers are as numerous as those who have posed them. Rather than searching for concrete answers, I approach digital poetry through a style of reading that is exploratory and open-ended, reviewing the literature and adopting terms, arguments, and/or rhetorical strategies that are expedient to my own line of thinking.

A digital poem is always more than its legible content; it is also composed or executed in a symbolic system of another kind altogether—i.e., computer code—and is therefore transmedial by necessity. Transmediality, writes Steve Gibson, "implies a level of direct connection and cross-over between mediums" (1). Some digital poems even foreground their status as products of

human-machine collaboration. Take Montfort's *Taroko Gorge*, generated by an elegant, little code written in Python and published to Montfort's website in 2009. *Taroko Gorge* generates an endless stream of poetic lines randomly selected from a limited pool of images and line compositions. Words are inserted into predetermined grammatical structures to form stanzas that move from one scenic location to another, as one might stroll through Taiwan's Taroko National Park. *Taroko Gorge* is best viewed in an internet browser, where the poem is generated at a comfortable reading speed before one's eyes and is unique each time the webpage is loaded. Alternatively, a sample of the generator's output can be read in Montfort's book *#!*, where a static version of the poem appears alongside its source code. In either case, *Taroko Gorge* foregrounds the fact of its transmediality.

Erín Moure's *Pillage Laud* also relies on computer-generated text as material for poetry, except that it is static and is distributed in book form only. Moure selects from sentences output by the freeware text generator MacProse to produce "lesbian sex poems, by pulling through certain found vocabularies, relying on context" (5). MacProse draws from an extensive and editable dictionary file to generate grammatically correct sentences. Where the small vocabulary of *Taroko Gorge* produces repetitive and thus meditative lines, the sizable dictionary file of MacProse enables a mind-boggling variety of combinations, which Moure then curates and edits to build her poem. Given that *Pillage Laud* and *Taroko Gorge* consist of text generated by a computer from datasets provided by a poet/programmer, I regard them both as digital poetry, though there are certainly differences in the publication of one executing live online while the other is fixed permanently in ink. I will unpack those differences in the following essays on computer mediation.

The Digital Revolution/Apocalypse

What is it about the transition from analog to digital formats that prompts media theorists to make sweeping claims about a perilous or paradisiacal future? Some theorists conceive of the turn toward digitalism as a revolutionary paradigm shift heralding a utopian society, while others regard digitization as the hallmark of a looming apocalypse. McLuhan, for one, envisions an electrified future society wherein everything is automated, interconnected, and functionally non-linear—i.e., less 'literary' and more 'visual', to borrow the terms he uses in *Understanding Media*—a citizenry freed from mechanistic constraints and loosed into an unlimited field of information. "Under electric technology," McLuhan writes, "the entire business of man becomes learning and knowing […] and all forms of wealth result from the movement of information. The problem of discovering occupations or employment may prove as difficult as wealth is easy" (65). And what a nice problem to have! Wouldn't we all rather be wealthy and underemployed than poor and overworked? Of course, much has changed since the 1960s, some in line with McLuhan's predictions, but the post-capitalist social revolution he foretells has not yet come to pass.

Other theorists, like the Neo-Futurists, view technology as value neutral and therefore capable of expressing new approaches to the future, even though it might be destructive today. "Neo-Futurism is a contemporary arts movement that manifests technology," writes Astra Papachristodoulou, "but it goes about re-thinking […] the functionality and aesthetic of fast-paced urban environments rather than seeing technological innovation as the answer for cultural rejuvenation" (69). Instead, Neo-Futurists approach technologies pragmatically, as potential means for communicating an alternate future, thereby shedding the harmful doctrines of the past. Matthew Phillips describes the Neo-Futurist perspective as neither utopian nor dystopian. "Works in this mode," he argues, "project a complex future contrary to the Futurist and transhumanist

ideal, where the human subject places itself in tension with technological progress, seeking liberation between the cracks of the monolith of capitalism" (qtd. in Papachristodoulou 69). Liberation in the cracks: hardly emancipatory, but Phillips imagines a future for humanity that is not entirely hopeless either. We return to the Neo-Futurist worldview in Part 2 when taking up Papachristodoulou's 3D-printed poem "artificial honeycomb."

On the other end of the revolution/apocalypse debate are theorists who feel digital technology is some sort of curse or progress trap, and, to be honest, this viewpoint has many historical precedents on its side. There is no question that technocapitalism has exerted devastating pressures on the natural environment and on myriad human social dynamics (labor relations, news media, etc.). The pressing concern for our purposes is to ask: to what degree are poets and scholars culpable for the sins of the system(s) in which they work? Byung-Chul Han's critique of digital media makes for a valuable foil against the overzealous endorsement of digital modalities. Han suggests in his preface to *In the Swarm* that high-tech societies are repeating a well-worn error by charging headlong into a class of technologies they do not yet fully understand:

> This new medium is reprogramming us, yet we fail to grasp the radical paradigm shift that is underway. We are hobbling along after the very medium that, below our threshold of conscious decision, is definitively changing the ways that we act, perceive, feel, think, and live together. We are enraptured by the digital medium yet unable to gauge the consequences of our frenzy fully. The crisis we are now experiencing follows from our blindness and stupefaction. (ix)

As technocapitalism perpetuates crisis after crisis, the methods of inscription used by all those living under it, including today's computer poets, are implicated at least somewhat in the expeditious orchestration of those crises. This is the social debt artists owe that Cecchetto insists

they pay by way of their art. The more beholden we are as a society to the technologies of our day, the more contemporary poets are obliged to consider and compensate for the detrimental effects of digitalism, even when used for ostensibly creative ends. This might involve interrogating the cleanliness of the energy consumed by the work, the ethics of the data acquisition or algorithmic processes used in its making, or the business practices of the company manufacturing the hardware it runs on, among other possible considerations.

Though they advocate against the overzealous embrace of digitalism, Martin Burckhardt and Dirk Höfer argue in *All and Nothing* that human artists contribute meaningfully to a programmatic world. The basis for this claim lies in their analysis of the philosophical implications of Boolean logic writ large, a present-day situation they refer to as the digital apocalypse. Essentially, Burckhardt and Höfer suppose that, as 0 and 1 shift from signifying specific values within an integer system to signifying opposite values in a binary system, they shed their meaning and become mere placeholders: 1 representative of presence and 0 of absence, where an absence is understood not as nothing, but rather the empty place of a potential something. 1, then, comes to signify any and every thing, and therefore no thing in particular. Both poles of the binary are emptied of meaning as reality collapses in a digital apocalypse, every instance of 'the real' finding its representation and subsequent annihilation in Boolean logic. And yet, Burckhardt and Höfer offer one backstop to this conceptual implosion, namely, the unaccountable influence of humans introducing value through unpredictability. "Value results when a human being does something that a machine cannot do," write Burckhardt and Höfer, "it results from action eluding the logic of formula" (39). The logic of formula grows to regulate more and more of human activity as digitalism progresses, and it is up to human agents to respond in surprising and unaccountable ways. From this perspective, human-machine collaboration appears to redirect world-ending

computational resources into creative pursuits, a view that positions digital poetry as one of the few arenas wherein we might successfully mount a critique of totalizing digital systems. Digital poetry is thus an act of reclamation, a reassertion of the human in an otherwise binary reality.

If digital poets can be evaluated against the imperative to complicate technological formulae, it follows that their readership should be at least passingly familiar with the formulae and conventions that poets might be working against. Literary critics who acknowledge the entanglement of reading and writing with digitalism are better prepared to assess the products of human-machine collaboration. In "Machine Use Subversion," Jeneen Naji theorizes digital literature as an 'art world' according to Howard Becker's definition, which is to say it exists as a collaborative network of people organized around shared knowledge and creative practices. A new art world may form around an innovative technology or medium if it engenders a community of participants actively making and sharing knowledge. The conventions of any particular art world become established as technologies and their corresponding techniques mature and propagate. The film industry, for example, coalesced around a new technology, forming techniques which have since become norms. Naji focuses on subversive practices in digital poetry—i.e., those disrupting literary conventions—which she defines as "subvert[ing] the primary use of a technology for poetic use" ("Machine Use Subversion"). This echoes Ramocki's suggestion to hack technology, though I get the sense Naji means that most consumer electronics are not designed for the composition of poetry, and so any poetic output is a form of subversion. This may be conflating the conventions of the technology in question with the conventions of the art world organized around that technology. We must ask: is a poet transgressive for 'misusing' a technology to compose poetry, or have they somehow transgressed against the newly-minted norms of the field?

Technological norms and genre conventions are not the only factors in assessing the subversive character of digital poetry. Critics can also weigh it against the expectations of readers, who by now are as immersed in digital text as they ever were in print. Amaranth Borsuk's historical survey *The Book* arrives at a notion of literature and the technology of reading that foregrounds diverse material histories. From clay to scrolls and codices to screens, literary vessels have transformed many times while remaining recognizably literary. Borsuk puts forward a persuasive reason: "All books […] arise in the moment of reception, in the hands, eyes, ears, and mind of the reader. The boundary-pushing cases of the artist's book and the e-book reveal the plasticity of the term and the diverse range of interfaces to which we apply it" (257). The book is a highly adaptive communications technology. Even the word 'book' is flexible; Borsuk is quick to point out that digital devices have been used as book interfaces since the early days of portable computing (1–2). Interactivity, hypertextuality, searchability, virtual storage, and other factors have entirely remade our relationship to literary texts, though what readers think of as literary has essentially remained the same, and this grounds the book as a concept across a variety of media and devices.

In *Who Needs Books?*, Lynn Coady also remarks on the relative stability of the book as a concept. After several decades of digital poetry, ebooks, and the internet, the print apocalypse foretold by techno-pioneers and pearl-clutchers alike simply has not come to pass. Culture is not debased by changes in the way we read, and change is normal, as Borsuk's survey makes abundantly clear. "The problem with this conversation," Coady writes, "is that it perpetually confuses capitalism with technology and technology with culture itself. Technology exists apart from, but is profoundly influenced by, capitalism, and the same can be said of culture" (35). My feelings about the co-constitution of technology, culture, and capitalism are tied up in Haraway's principle of sympoeisis; nevertheless, Coady serves as a valuable reminder that there is nothing

essential about the reciprocal effects of technocapitalist forces. Keeping the non-essential nature of these relationships front of mind helps to dispel the apparent inevitability of capitalist hegemony—or capitalist realism, as Mark Fisher calls it[7]—permeating techno-cultures.

Perhaps what skeptics of digitalism are afraid of is not so much the extinction of print-based culture, but a demotion in its status. Unlike most literary writers, readers have embraced the changes brought about by the internet; consider the sheer volume of email, instant messaging, and social media circulating at any one time. What is apparent in spite of digitalism is that interacting with a physical book is a sensory experience computers do not replace. Computers rather add to the host of literary pleasures cultivated in print. Digital forms of reading have dispelled the notion that literary culture is driven by iconoclastic authors addressing an erudite and discerning reading public—i.e., a readership upholding the status of the book and the cult of authorial genius—revealing instead the vast, disorganized, and hedonistic reading practices of the public en masse. Coady identifies the root of our collective anxieties about the future of the book as "a fear that soon the temptations of technology will become so alluring, we'll forgo our humanity and all its physical pleasures and encumbrances altogether. […] You might say, the fear of relinquishing our humanity is as human as anything else about us" (41). I think Coady puts her finger on a fundamental tension underlying posthumanist theory: the innately human concern that augmentation might diminish our humanity, to which I respond that, just as PDFs do not devalue the sensory experience of interacting with printed books, augmentation cannot lessen what it means to be human.

Coady goes on to quote Rebecca Solnit on reading books: "The object we call the book is not the real book, but its potential, like a musical score or seed. It exists fully only in the act of

[7] See Fisher, *Capitalist Realism.*

being read; and its real home is inside the head of the reader" (43). Solnit's notion of a book's "real home" calls to mind the augmented reality poem *Between Page and Screen* by Borsuk and Brad Bouse, which also questions the space where reading occurs. If reading happens where a human consciousness interfaces with a symbol system, then the production of meaning is characterized by reception, activation, and interpretation. This is as it has always been, which is to say that reading has always taken place in a kind of augmented reality. Following Coady, we see that McLuhanian idealism about the media revolution comes from a naïve faith in the movement of technology and capitalism away from individual wants and perceptions, and toward socially beneficial ends. If literary space exists where a readership engages with content, then medium is a co-determinative factor in meaning-making; it informs the reception of, but cannot predetermine, the message, which is different for each reader. I say more on this subject, and on *Between Page and Screen*, in Part 3.

To frustrate the idea of a digital revolution even further, C. T. Funkhouser demonstrates that the notable features of digital poetry were established well before the internet brought them together to constitute a genre. In *Prehistoric Digital Poetry*, his survey of early electronic literature, Funkhouser goes so far as to claim that "[o]ne cannot successfully argue […] that the works produced for the WWW radically advance poetic form" (235). He also argues that ideologies shift with changes in literary technique. Funkhouser writes:

> The aesthetics and motivations of the computer artist embody and diverge from compositions displayed and discussed in anthologies of concrete poetry. A relationship between graphical digital poems and concrete works often exists on the surface but is not intrinsically supported with shared ideologies or methods, especially in contemporary forms where fewer (if any) elements are fixed onto a page. (87)

I agree that digital poets have not necessarily taken up the ideologies of concrete poets—that their modes share features, but are not therefore contiguous—though this observation contradicts Funkhouser's opinion that the internet does not fundamentally alter poetry. Discourse in this field still has one foot in its formative stage, and without recourse to tidy progressivist narratives or doomsday prophecies, it seems digitalism has produced in literary scholarship a confounding onslaught of new questions and concerns. The next section treats this proliferation as it relates to digital poetics as an emergent field of study.

Contested Definitions of Digital Poetry

Digital poetry has proven difficult to define, as you might expect given the newness of the field, the rapidly developing technologies involved, and the slipperiness of critical terminology. Categorical definitions of poetry were fraught before the advent of computers, and they are no less so now. Poetry is an open-ended category intersecting with many other literary forms, styles, and genres. I have chosen to anchor this research in poetics because the majority of the cases covered in this study are identified as poetry, and because I am a poet, which colors the way I read. For these reasons, I will entirely skip over the question of defining poetry as distinct from other kinds of literature. Some of my claims will apply to electronic or computational literature, or contemporary literature in general, but for the purposes of this study I'm primarily interested in the influence a digital apparatus exerts on poetic text. As mentioned in the Introduction, I feel poetry pays close attention to the materials of language, particularly the ways form and content inform each other. The addition of machine language into the mix introduces new material elements to which readers and scholars may direct their interpretive attentions.

Though something of a niche field, digital poetry is worth studying because it is hotly contested. The pressure digitalism exerts on poetics is a microcosm of the pressures put on humanities disciplines across the board, shifting whole fields toward digital practices. The gravity of this shift has all but guaranteed fervent debate among literary scholars about what now falls within the purview of their field. Despite the ink already spilled on the topic, the question of where poetry ends and digital poetry begins has hardly been settled. Funkhouser suggests that critics must wrestle with the definition of digital poetry at the outset of any critical approach to electronic literature, at least until the boundaries of the field have concretized (24–25). Leonardo Flores and Loss Pequeño Glazier go further, claiming the impossibility of a comprehensive definition of the field.[8] In response, James O'Sullivan argues for an ad hoc or descriptive, rather than prescriptive, interpretive framework, one tailored to the specifics of the work at hand (50).

The impracticality of grouping all instances of digital poetry under a single definition results largely from the fact that software and hardware are ever-changing on a technical level; machines come and go, programming languages rise and fall, and poetics are continuously diverging. Nevertheless, there is one recurrent concern localizing the study of digital poetics to a set of common questions, the most common being: what qualifies a poem as digital? Does the poem have to be both written and read on a computer, i.e., must it involve the execution of code? Funkhouser, Glazier, and others argue yes. Scott Rettberg, for example, insists that, to be considered digital, "the computer (or the network context) must be in some way *essential to* the performance or carrying out of the literary activity in question" (emphasis Rettberg's). In general, this means digital poetry is not amenable to publication in print, perhaps because of its hypertextual, interactive, or other transmedial qualities. From this perspective, works of electronic

[8] See Glazier 63; Flores, "Digital Poetry."

literature are both a reading experience and a computer application, making readers into users as well. The implication of this shift is an overlap of interactive and interpretive positions like ‘user’, ‘reader’, ‘writer’, and ‘viewer’ as their functions become increasingly intertwined; in fact, a single person may occupy all these positions at once.

O’Sullivan and Flores contend that there need only be a conceptual link between a poetic work and digital methods of production for it to qualify as digital poetry. This expands the field to include codework—poetry written to look and read like code—and printable works of text generation, like Moure’s *Pillage Laud*. With these works in mind, I feel it is necessary to reframe the debate around different questions: for instance, how computer mediation alters a poem, or to what degree digitalism influences its interpretation. Framing critical inquiry this way avoids the trappings of definitively labeling a poem digital or not. Even so, the question invites another: which applications of computational processing constitute meaningful involvement—‘meaningful’ in the literary sense of conveying meaning—in poetic texts? To determine the necessity of the computer, critics have offered various schema suggesting the parameters which qualify a poem as digital. A summary of critical schema is organized into table 1. Note that not all characteristics identified by each critic need apply for a poem to count; rather, these characteristics contribute to the degree a poem is considered digital.

Table 1

Characteristics of Digital Poetry as Proposed under Several Critical Schema[a]

	Eichhorn	Flores	Funkhouser	Glazier	Golumbia	Hayles	Montfort	Naji	Rettberg	Spinosa
Codework		x				x				x
Collaborative					x					
Computational				x			x		x	x
Executable	x		x	x			x	x	x	x
Generative	x	x	x	x		x				
Hypertextual			x	x	x	x			x	
Interactive		x				x			x	x
Multimedial		x		x	x	x				x
Networked			x	x		x				
Nonlinear					x					
Portable					x					
Preservable					x					
Translative	x		x							
Visual/Kinetic		x	x			x				x

Sources: Eichhorn, “The Digital Turn in Canadian and Québécois Literature;” Flores, “Digital Poetry;” Funkhouser, *Prehistoric Digital Poetry*; Glazier, *Digital Poetics*; Golumbia, “Characteristics of Digital Media;” Hayles, *Writing Machines*; Montfort, “Computational Literature;” Naji, “Poetic Machines;” Rettberg, “Electronic Literature;” Spinosa, “Toward a Theory of Canadian Digital Poetics.”

a. Note: tabulated from sources offering categorical schema. This table is illustrative of the scattershot categorization of digital poetics. Most of these critics have authored several works on digital poetry and may expand or restrict their criteria elsewhere. I have drawn from sources which may refer to digital/electronic literature in general, though their terms apply equally well to poetry.

Critics use the terms in the leftmost column somewhat differently, so this list is reductive by necessity. See Appendix 1 for a glossary of terms.

Given the range of attributes proposed to qualify a poem as digital, table 1 confirms the lack of any one definitive set. As I do not wish to negotiate which qualities are necessary and which are not, my attention through the remainder of this section is on the most conspicuous exclusions and limitations of the various frameworks summarized here, adding nuance to the discussion without over-determining our idea of what constitutes the field.

Many of the earliest critics of digital poetry investigated its connection to the pre-digital print cultures from which it emerged. In his introduction to *Digital Poetics,* Glazier puts a premium on innovation and contends that digital poetry inherited the mantle of 'literature's foremost boundary-pusher' from the twentieth- and early twenty-first-century avant-garde tradition. Digital poetry earns this inheritance on the basis of its algorithmic similarities to the highly-procedural writing practices of, for example, Oulipian and Conceptual poets. The primary difference between digital practices and these procedural forerunners is that in the latter a human performs the procedure, oftentimes repeating it ad nauseum to fulfill its terms. I find this association, made over and over by scholars,[9] much like Funkhouser finds the relationship between concrete and digital poetry: "exist[ing] on the surface but […] not intrinsically supported" (87). Following Spinosa's critique of contemporary Conceptualist writers in *Anarchists in the Academy*, I argue that the Herculean feats of procedural labor accomplished by the avant-garde and Oulipian writers of the

[9] Spinosa covers poetry by Jackson Mac Low, John Cage, bpNichol, and others in *Anarchists in the Academy*; Emerson's *Reading Writing Interfaces* features a chapter on bpNichol, Steve McCaffery, and Dom Sylvester Houédard; Schmaltz, too, writes on bpNichol, and also bill bissett in "From the Digits to the Digital."

twentieth century seem pitiful relative to the computational power of today's machines.[10] Human and computer procedural labor are of entirely different classes. For this reason, and despite insisting that digital poetics emerged from print-based poetics, Glazier argues that electronic literature participates in a paradigmatic shift in our understanding of reading and writing.

Glazier argues that, in addition to pushing conceptual boundaries, digital poetry requires a computer interface to qualify, a common stance among critics. Funkhouser in particular highlights work both made and consumed on a computer, excluding merely "mechanically enabled" poetry from the scope of his study (25). He even reserves an analysis of codework and holographic poetry for appendices in the back of *Prehistoric Digital Poetry*, given that these forms are not necessarily viewed on a screen. Digital poems, as Funkhouser defines them, exist in execution and "bear elements of performance and translation. […] Digital poetry is a creative, interdisciplinary exhibition or 'screening,' where language and computers serve as mediators, as contemporary interpretations of writing" (235). This is of special importance because, as noted in the previous section, Funkhouser feels that digital poetry's salient features originate in pre-digital contexts and are thus most easily distinguished from print-based poetics by their mediation via screen. David Golumbia, too, defends digital poetry's analog lineage, pointing to "decades or even centuries of predigital practice." Each of his qualifying characteristics—nonlinearity, multimedia, hypertextuality, collaboration, portability, and preservation—have their sources in print culture. While only one parameter in Golumbia's schema overlaps with Funkhouser's (see table 1), they still agree that the primary characteristics of digital poetry are present to some degree in print.

[10] Take the famous Oulipian N+7 procedure, which replaces every noun in a text with the seventh subsequent noun in a chosen dictionary; imagine manually applying this technique to a novel like *Moby Dick*, substituting each noun one by one through a tedious process of scanning and cross-referencing. Given that computers can now accomplish this maneuver in the blink of an eye, no contemporary author in their right mind would manually perform the N+7 procedure on a lengthy text.

To my mind, it is insufficient to argue that the paradigm-changing qualities enumerated in table 1 are merely the fruit of earlier experimental traditions because it suggests that computer interfaces and executable code are meaningful only insofar as they distinguish digital from pre-digital poetry. Though he traces digital modalities back to analog ones, Montfort distinguishes between computational, electronic, and digital literatures. Computational literature does not strictly require a "general purpose, electronic, digital computer"—indeed, any operation using commands to manipulate symbols according to a system counts as computational—while electronic literature incorporates a powered device, and digital literature requires that device be a computer (Montfort, "Computational Literature" 206). Given that algorithmic methods are used in all sorts of literary forms and genres, Montfort proposes that computational literature as a category lacks clearly defined boundaries and should thus be considered "radial" ("Computational Literature" 207). By radial, Montfort means that computational techniques intersect with many other compositional practices, including pre-digital ones. Even though computational writing prefigures the other two classes, Montfort maintains that the application of digital processes has led to "the emergence of qualitatively new phenomena" calling for entirely new interpretive and critical frameworks ("Computational Literature" 208).

When it comes to things computers can do that books cannot, critics make much of interactivity. A digital poem is interactive if it receives real-time feedback from the reader determining or modifying its content in some way. Spinosa argues in *Anarchists in the Academy* that interactivity increases readers' interpretive agency. Montfort characterizes the heightened interactivity computers offer readers as a product of their power to index and retrieve vast arrays of data, specifically "objects within objects," which I take to mean the hierarchical structures enabled by object-oriented programs ("Computational Literature" 211). In programming, objects

contain both data and code, i.e., both content and function. An object is an individual instance of the class to which it belongs, possessing unique values for the set of variables common to that class.[11] Objects can interact with each other and with readers to generate new outcomes in flexible, open-ended systems such as we might find in interactive storytelling, but computers take the 'choose-your-own-adventure' narrative model to unprecedented new levels. Moreover, objects can be nested within each other, leading to the processing and manipulation of ever-more complex arrays of linguistic data. Take, for example, the rules governing the nested grammatical structures of the MacProse text generator Moure used to compose *Pillage Laud*; sentence templates are nuanced with randomly-selected sub-templates before the "sentence tree," as MacProse programmer Charles O. Hartman calls it, is populated with words (1). Not only is the vocabulary of MacProse highly variable, so too are its sentence constructions. Montfort offers object-oriented programming as a profound figuration for reading digital literature, not by following a linear sequence of instructions, but by navigating a network of responsive, modular, non-sequential literary potentials. I find Montfort's view of digital literature helpful in that it moves past the necessity of the computer interface to engage with the underlying structures of machine language enabling the paradigmatic shift heralded by Glazer and Funkhouser. Importantly, these structures can manifest in poetry presented both on and off screen, as is clearly the case with computer-generated text published in a printed book.

Transmedial poetry points to a different kind of relationship between humans and machines, one less dependent on the computer interface itself and more on the influence of its mediation via machine languages. The Electronic Literature Organization (ELO)—whose stated

[11] To illustrate, individual people can be seen as objects belonging to the human class, each with their own name, height, weight, and age values, qualities that every human has.

aim is to facilitate and promote the writing, publishing, and reading of literature in electronic media—seems to allow for computer mediation at any point in a literary work's lifecycle. Flores follows Hayles, his predecessor as president of the ELO, in arguing that digital poetry must be more than marked by digitalism, it must be actively formed by the mediation of a computer, regardless of when this mediation occurs. By this, I take Flores to mean that the poem simply could not exist without using a computer to read or write it. In his survey of digital forms, Flores speculates that the future of digital poetry will involve "going beyond the personal computer as a space for the reception of digital poetry" ("Digital Poetry"). Flores refers to this vision of literary practice, including technologies like augmented reality and touchscreens, as the fourth wave or generation of digital literature, a distinction I'm suspicious of because the boundaries between generations are always arbitrary.

Moving beyond the personal computer into extended reality environments also complicates the boundaries between physical and virtual worlds. In fact, digital poetry is characterized by its complication of boundaries of all sorts: between human and computer, node and network, natural and machine language, and so on. The parameters covered by the various schema of table 1 address, but cannot encompass, the shifting grounds of the field. The same goes for the boundaries imposed by pre-digital literary criticism: genre, publication format, nationality, etc. With respect to Canadian and Québécois digital literatures, Kate Eichhorn writes, "[u]ltimately, these dilemmas point to the fact that digital literature not only brings us beyond the book but also beyond the categories we continue to rely on to theorize literature, posing a challenge to the presuppositions at the centre of 'Canadian literature' itself" (513). All this confusion of categories prompts us to ask: why might the boundaries around digital poetry be especially amorphous? Rettberg, for one, supposes that the field remains nebulous largely because it is "not yet tied to any specific market

logic". To put it bluntly, until publishers find ways to standardize and profit from digital poetry, it will continue to proliferate in unpredictable directions. Rettberg also points to the plethora of tools and techniques coming into and falling out of popular usage, and the range of skills one might develop to make use of them, suggesting that the only creative constraints on digital poetry are "those that the authors choose for themselves."

Degrees of Mediation

Despite having the fewest qualifying characteristics, Naji's is perhaps the most inclusive schema of those covered in table 1. Her chapter "Poetic Machines" depicts poetic meaning-making as a collaborative process whereby the programmer/poet, the user/reader, and the computer work together to "create new digital communicative experiences" (146). From Naji's perspective, all poetry presented electronically qualifies as digital poetry, which she refers to as ePoetry, whether it be conventional, text-based poetry simply displayed on a screen or experimental work making use of techniques exclusive to the digital environment. This expansive definition is convenient in that there is little to quibble over regarding the necessary traits of digital poetry. A work need not employ hypertextuality, interactivity, or any other technique proposed as a defining feature of the field, besides, of course, the fact of its computer mediation. Naji reasons that a digital poem is more than a representation in the sense that poetry usually represents objects, experiences, or emotions; digital poetry must be executed to run, it is the product of a "simulation machine" and is therefore an event ("Poetic Machines" 157). The distinguishing characteristic of digital poetry is that it is a simulation of a representation in addition to being representative in the usual way. However, Naji draws a line between conventional poetry—haiku, for instance—written with a word processor and the same poetry printed out. The former qualifies as digital poetry by virtue of

the computer terminal, while the latter forfeits its claim to the digital and becomes analog during its transference to paper. “In this case,” Naji writes, “the apparatus is used as a tool for the creation of a poem but is not essential for accessing it” (“Poetic Machines” 159).

I think Naji is forgetting the impossibility of this analog text without the computer, the printer, the network through which they communicate, the electricity on which they run, the power company, and the sociohistorical circumstances of their production, maintenance, and use. Once something qualifies as digital poetry by Naji’s definition, it should always be considered as such. I argue that poetic work mediated by digital infrastructure of any kind bears the hallmarks of digitalism. It is possible that the very existence of computer poetry, not to mention the proliferation of digital systems all around us, draws every instance of contemporary analog poetry into dialogue with it to at least some degree. A poem composed with a pen on paper no longer exists outside the cybernetic system, and while the mere presence of accessible digital tools cannot oblige poets or critics to pick them up, deliberately avoiding them is itself a choice. For this reason, I conceive of digitalism in literature as operating on a spectrum with no computer mediation on one end and pure digital virtuality[12] on the other. If we regard each extreme as an asymptotic limit—i.e., if we maintain the impossibility of a contemporary poem being either entirely digital or entirely free from the influence of computers—then every poem written today can be located somewhere on this spectrum. The preceding review of critical schema indicates plenty of scholarly disagreement as to where on the spectrum a poem needs to be in order to be considered digital. I reiterate that almost every critic mentioned above readily admits that frameworks making distinctions along these lines cannot possibly be definitive. There are simply too many ways computers mediate human language. Determining which ways are essential becomes an arbitrary exercise when

[12] 'Pure digital virtuality' means something like 'immaterial' or 'simulated'. Pure virtuality exists only as a concept because all simulated systems run on material ones, and are thus to some degree material.

viewing computer mediation as a spectrum; rather, the proper question is to what degree a poem has been influenced by computer mediation.

Naji also makes the mistake of discounting executable code as extra-literary: existing in support of the poem, but not a part of it.[13] She echoes media critic Jenny Weight in asserting that "the algorithm or code itself is not visible to the human, it is not a performative element therefore it is not 'an object for hermeneusis' however it allows the ePoem to exist" (Weight, qtd. in Naji, "Poetic Machines" 158). Given Naji's insistence on the execution of code for the poem to qualify as digital, I would have assumed that the text as it is processed by the computer would remain an object of literary analysis. It seems contradictory to claim that executable code is an essential feature of digital poetry, then ignore the code when it evaluating the work. Surely, nothing other than the code itself performs the poem, or perhaps the code in conjunction with the apparatus and the user, a conceptual space Naji rightly identifies as vital to the experience of digital poetry. What users see are the surface-level renderings of internal processes which determine, to an extent, the manner in which they receive the poem. Besides that, the code itself is not always hidden from or otherwise unavailable to users. Programmers are known to put Easter eggs in their software, code is oftentimes documented with non-executable comments, and readers may be able to change parameters or even hack the poem. These are all avenues into literary experience, interpretation, and co-creation digital media makes possible. If literary criticism is to take every poem presented on the screen of a computer as digital poetry, as Naji does, then it should also account for the mediation of poetry by an apparatus and its attendant machine languages while reckoning with

[13] Gérard Gennete calls supporting material 'paratext' and distinguishes between 'peritext', which comes with the text and is visible to the reader, and 'epitext', which is external to the text altogether. Gennete describes paratext as the "threshold" between the interior of the text and its exterior, or rather "the discourse of the world on the text" (Gennete and Maclean 261). Either way, paratext is "the fringe of the […] text which, in reality, controls the whole reading" (Lejeune, qtd. in Gennete and Maclean 261).

creative practices that resist or ignore computational techniques. All these intersecting and competing interests constitute the field of digital poetry.

O'Sullivan proposes similar concerns with respect to the interpretation of individual poems in *Towards a Digital Poetics*. He resists determinative classifications of digital poetry and stresses "electronic literature's [internal] *difference*" (xvi, emphasis O'Sullivan's). After wrestling with and rejecting various generalized definitions of the field, O'Sullivan offers a provisional definition of digital poetry in the final chapter, one that receives a poem on its own particular terms:

> Electronic literature requires both the technical form and linguistic content to work in unison: it is about the formation of a matrix of media and experience which encapsulates meaning through a variety of means, each of which operates within a singular artistic space, that space being defined by the parameters of the work in question. (122)

Poetry establishes its own literary space, where content, materials, and experience come together in the act of reading, and thus literary criticism, for O'Sullivan, must ask if the digital medium contributes to this space in some essential way. Only a provisional definition of digital poetry will apprehend the transmedial strategies at work behind the artifact to determine if computation has made the poem possible. Requiring an essential link between the digital medium and the poem's message leads O'Sullivan to reject what he calls the "all literature" hypothesis—the theory that every text touched by a computer qualifies as digital—but he accommodates as wide a definition as possible besides that (24).

Heike Schaefer, too, insists that it is impossible to prescribe a definition amenable to all of digital poetry, though she holds even fewer scruples than O'Sullivan regarding what qualifies as such. Schaefer argues that categorical distinctions are a waste of energy for readers appreciating the literary field in all its transmedial variegation. Literature, in her view, is not a self-contained

medium, like painting or music; it invokes a network of attitudes, perceptions, techniques, and technologies, and is more a transmedial cultural practice than a stand-alone art form. In "Poetry in Transmedial Perspective," she writes:

> [I]t seems crucial to insist that all versions of a literary text—and the different modes of composing, disseminating and engaging with the text that these entail—are part of literary culture. They belong to the medium of literature, no matter to what other medium they may also belong. (178)

Schaefer looks for significance in the transitional spaces between media, and, because transmediality is antithetical to categorical thinking, she rejects the need for any such distinctions. The question then becomes, if each new instance of digital poetry produces its own formal classification based on the unique blend of its transmedial relationships, how do we talk about each instance as part of a larger literary field that is itself interwoven with many other disciplines? To approach this problem, Schaefer suggests that, first and foremost, critics develop "a new understanding of literature as a medium," or rather, "of the mediality of literature" (170). All aspects of a poem, from its drafting on paper to the code of its execution and display on screen, are drawn into its conceptual space. Digital literary studies, then, is not merely adjacent to media studies; these fields overlap and, in combination, offer insights into transmedial writing that are not possible by either discipline alone.

After considering several conflicting approaches to digital poetry, I find myself identifying most strongly with Schaefer, whose position I also happen to think is most consistent with posthumanist theory. To illustrate, a hypothetical question: if you write a poem with ink and a quill on parchment but have Wikipedia, the Oxford English dictionary, or any other digital resource open in front of you, how is it not a digital poem? Referencing a print thesaurus or encyclopedia

is not the same as conducting research using networked, hypertextual resources. Consequently, the way you navigate through the reference material, how the neural pathways in your brain are activated during composition, and therefore which content makes its way into your poem, is cybernetic. Reading digital poetry critically requires looking beyond the words and into the material and informational networks intersecting behind it, including layers of various machine languages. I return to the topic of cyborg reading practices in Part 3, so for now I stress that, although it may be hidden, executable code operating beneath a reader's awareness nevertheless exerts substantial influence over their interpretation of a digital text. The impact of computer code on poetry is an important factor to keep in mind even if we choose not to read code. Again, the fact of its existence does not oblige analysis—regardless of how 'essential' critics find executability is to digital poetry—but code constantly addresses readers in ways that inform our experiences of poetic texts both on- and offline.

Boundary Blur

So far I have treated the complication of categorical boundaries as a symptom of introducing digital devices between poets and poetry readers, but these complications cannot be mere happenstance. What of the poets who find disciplinary boundaries too restricting and so knowingly and actively work to erode these distinctions? What if boundary blur were a primary creative goal, a reason to use computers in the first place, as tools for transmedial expression? As I argued in the previous section, all contemporary poetry can be located on a spectrum of computer mediation, though only some computer-mediated poetry engages conceptually with its status as digital. For the purposes of this study, I have focused on computer-mediated poems that grapple with their existence as material phenomena crafted with digital tools. Many of the cases I draw upon are explicitly transmedial, with multiple versions of a poem accessible through different

interfaces. Tucker's *Loss Sets*, for instance, can be read as text from a printed broadside, viewed and manipulated as a virtual model on a computer screen, or interacted with physically as a 3D-printed object. None of these instances are the primary version of the poem; rather, to borrow O'Sullivan's concept, the singular artistic space created by and for *Loss Sets* is a union of several modalities. It traverses the various media of computer hardware and software, as do all digital poems at some point in their lifecycle. This understanding of digital poetry does not conflict with the theory that all literature mediated by a computer qualifies as digital, even if it is printed out, which O'Sullivan shies away from and I embrace. For maximum clarity, my case studies attend to poems that are explicitly computer-mediated, or which reflect the conceptual necessity of the computer critics like O'Sullivan ask after.

While on the subject of boundaries, we must address the imposition of national borders on the field of digital poetry. Spinosa, Eichhorn, and other Canadian scholars make overtures to an admittedly amorphous Canadian digital poetics,[14] though, as already noted, Eichhorn argues digital poetry "pose[s] a challenge to the presuppositions at the centre of 'Canadian literature' itself" (513). As for a national literature, I personally have very few nationalistic inclinations and do not position my work as an assertion of political boundaries, though I do see the expediency of grouping authors and projects this way for comparison and study. There are institutional factors reinforcing national literatures, such as the distribution of arts and culture funding or the enforcement of property rights via copyright law, issues that cannot be avoided by literary criticism. Additionally, I'm conscious of the overwhelming influence of American and British media and scholarship in the Canadian context, and suppose that the reassertion of literary studies

[14] See Spinosa, "Toward a Theory of Canadian Digital Poetics;" Eichhorn, "The Digital Turn in Canadian and Québécois Literature;" Schmaltz, "From the Digits to the Digital."

from a local viewpoint is useful as a bulwark against the erasure of unique critical and creative perspectives. On the other hand, digital poetry frustrates nationalistic taxonomies, as it often involves international collaboration or decentralized publication. While I am interested in local and regional literary culture as discrete from American, British, and other Anglophone cultures, it remains true that national distinctions reflect political inventions that may falsely contextualize or impose a reading on a digital poem.

To wit, I feel the most glaring problem with Canadian literature as a categorical framework is not that it struggles to account for international collaboration, but that nationalist classification systems re-inscribe colonial divisions which subject Indigenous peoples and cultures to erasure. Decolonial literatures, for example, are not adequately described by virtue of their production on one side or another of an arbitrary national boundary. To label as Canadian a poetry collection like *Un/Inhabited* by Nisga'a writer Jordan Abel would be to misconstrue the work entirely, repeating an imposition of the Western genre conventions Abel writes against. In *Un/Inhabited*, Abel manipulates found text with digital and visual techniques to comment on the colonization of historical narratives via the written word. Abel compiles text from Western pulp novels in the public domain to form a corpus, then applies key word in context (KWIC) searches—typically used in the digital humanities (DH) for generating concordances[15]—to extract full sentences containing his search terms from the corpus: words like 'territory', 'uninhabited', 'pioneer', and 'frontier', which are common in the Western genre and tend to represent Turtle Island as an unpopulated wilderness practically inviting its own colonization. Abel presents the extracted sentences in the first section of *Un/Inhabited*, "Pioneering," with the search term erased, leaving

[15] Concordances are alphabetical lists of the important terms used in a book or corpus, listing every instance of each word within its immediate context, i.e. along with some of the surrounding text. Historically, concordances were used as searchable indices of key terms and their usage in large and important documents, like religious texts. Now, concordances are commonly used to build statistical models of language based on word usage.

blank spaces where the key words used to be. For example, “How lonely I felt in the uninhabited bush!” becomes “How lonely I felt in the bush!” (Abel 13). Abel’s erasures perform a reversal of the original erasure enacted by English-language literature, repopulating a land portrayed as empty while leaving a white scar where the wound occurred. To call this work Canadian or Western would be antithetical.

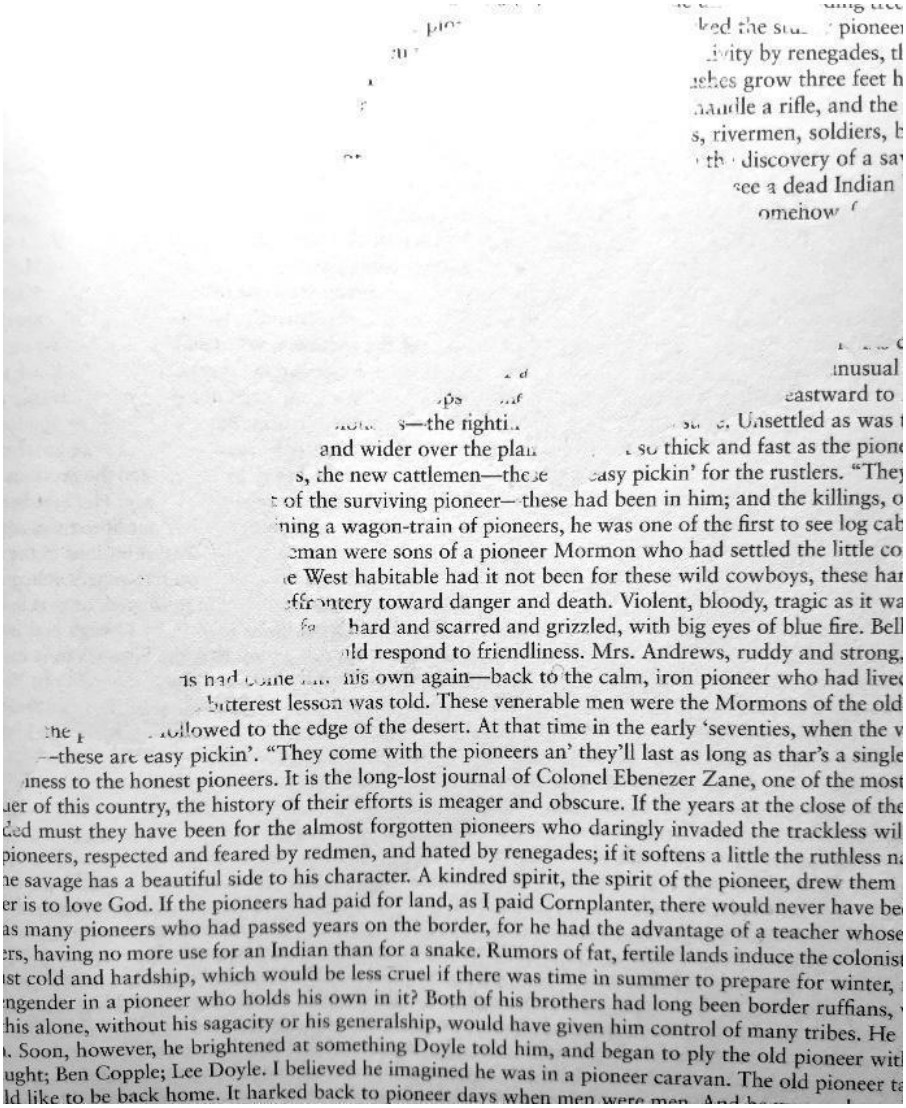

Figure 3. “Cartography” from *Un/Inhabited*, scanned excerpt (Abel 137).

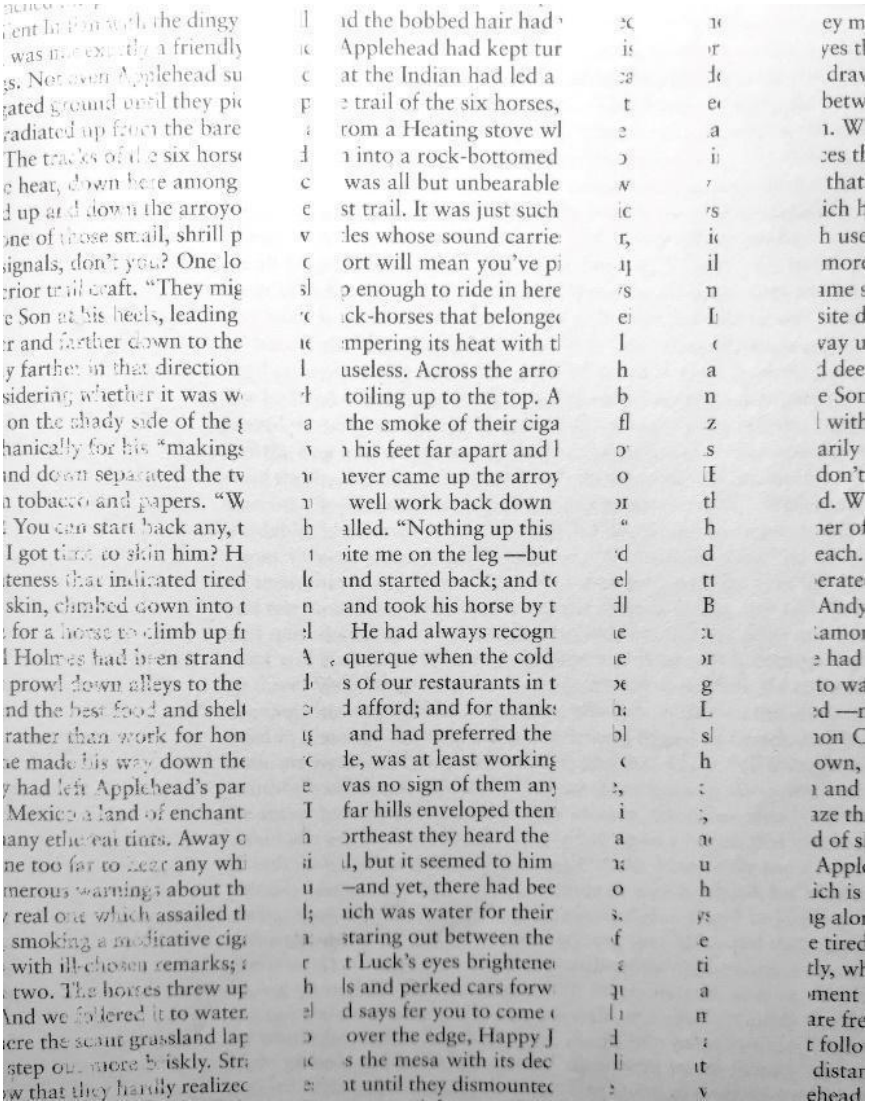

Figure 4. “Extracted” from *Un/Inhabited*, scanned excerpt (Abel 177).

In addition to accessing a public domain corpus and applying KWIC search and copy/paste functions, Abel further processes his extracted text using a digital image editor to generate sequences of poetry that critique colonialism through visual means. “Cartography” shows a series of coastlines where the water is filled with text and the land is left blank (see figure 3). At first it seems like the land is being invaded by wave after wave of Western pulp narratives which treat the land as vacant, but, as the series progresses, more and more of each page is consumed by

landmass, driving the text back beyond the conceptual space of the book. The final sequence of poems, "Extracted," repeats the visual decolonization of the page, this time through an accumulation of blank columns and apparent printer errors (see figure 4). "Extracted" in particular draws our attention to the book as a printed object, directly linking the conceptual and material concerns of poetry with the ongoing conditions of colonization, wherein language and page-space are contested like land. The effect is to destabilize the relationship between colonial powers and the communications technologies they wield to assert their dominance.

As with Moure's *Pillage Laud*, the computational techniques Abel applies to his source text could have been accomplished manually using analog methods, but in both cases computer mediation not only speeds up their word search and selection processes, it changes the significance of the resultant text. Even though *Un/Inhabited* is a printed book, I can't imagine a context outside of digital poetics in which this publication could exist, given its method of production. *Un/Inhabited* is also an example of DH criticism exhibited through creative practice, otherwise known as research-creation. The work employs DH techniques to test a question posed by Abel-as-researcher, who gathers and represents evidence about the object of analysis through graphical means nonetheless comprehensible to readers. That Abel-as-poet exhibits his findings in a visually pleasing and emotionally affecting manner does not disqualify it as a work of criticism. In my opinion, *Un/Inhabited* is more expressive, more useful, as criticism than other forms of data visualization popular in DH: topic-modeled word clouds, for instance. Both Abel's work and word clouds make arguments about data in their formal presentation, but only the former manages to interrogate the sociohistorical dimensions of literary quantification. As Western-style academia prefers empiricism to other forms of analysis and expression, Abel turns the tools of empiricism inward to reveal its limitations and contradictions. Many scholars of digital poetry are also

practitioners, as I mentioned in the Introduction, but Abel is one of the few using analytical tools like KWIC searches to furnish creative material. I am surprised there are not more co-claimants to digital poetry and DH, digital creation and computational analysis, literary production and media studies.

Fields treating human language—which both linguists and computer scientists refer to as natural language—overlap considerably in the digital environment. It is beneficial for readers of digital texts to come to grips with the computational means of natural language processing. A computer does not read a sentence the way humans do and cannot be said to apprehend its meaning. Instead, computers treat text as a series of discrete values that it can count and compare by quantity and position. Statistical values like word frequency, order, and co-location (or concordance) may seem arbitrary relative to the semantic content of the words themselves, but as Thierry Poibeau points out in *Machine Translation*, human cognition also depends on these factors to reach a correct understanding of any particular utterance in context—tracking, for instance, the topic of a sentence or paragraph as it unfolds. However, computers are more adept than humans at reading beyond local contexts because they can quickly compare words from disparate paragraphs or even different texts. Massive corpora of training data allow for the development of statistical models of language comparing the usage of a word in its local context to its usage in many thousands of contexts without losing granular detail.

One of the most fascinating aspects of statistical models is how they understand words purely from the context of their use, with no guiding principles like syntax or grammar programmed in.[16] Linguistic structures are implied by the data, rather than imposed by rules, and

[16] There are systems predating statistical modeling which start from basic rules and build out from there. Poibeau covers these in detail in *Machine Translation*.

thus better account for the vagaries and contradictions inherent in natural languages. Poibeau claims that statistical treatments of language could even lead to a "new theory of meaning," one demonstrating that the meaning of a particular word emerges from the non-linear and highly contextual relationships formed between it and many others (179). Moreover, every word in a digitized text is readily and equally accessible to machines at all times, so computers can easily quantify and compare the relationships between them. This practice may seem counterintuitive to literary critics accustomed to the linearity of human reading practices, even though data storage, retrieval, and manipulation are the fundamental operations of any computing system.

Given that natural language in a digital environment is mediated by a host of machine languages and the fundamental operations they are built upon, it is unsurprising to discover blurring between linguistic classes. Take, for example, the word 'print': so far I have used it to connote several different things meaningful in the literary register—ink on a printed page, the medium of physical publication, the reproduction of documents and objects, etc.—though print can be understood within the context of various programming languages as well. 'print' is a function in the Python programming language instructing the computer to show specified parameters in the program's text output. Python derives from ABC, a programming language and environment itself influenced by BASIC, where the 'PRINT' command is prominent. Obviously the word print was chosen for this function because its meaning is evident to human programmers; what is less obvious from a literary perspective is how the machine recognizes this string of characters, then executes the instruction it represents. Python is considered a programmer-friendly, or higher-level, language in that its instructions and syntax are modeled on natural language. Machine-friendly languages, on the other hand, are structured around computational mechanisms and are more efficient to run, but less familiar-sounding to humans. Higher-level languages need

to be translated into lower-level ones, and ultimately into binary code, to be legible to the computer's hardware.

Natural language processors are vulnerable to mistranslation and error—and therefore to creative intervention—because of their layers of mediation and the misalignments between natural and machine languages. Tucker, who spoke on the hierarchy of machine languages during his DHSI presentation, makes creative use of slippage between languages to produce *O/Ô*, a suite of visual poems wryly exposing the limitations of machine translation. Tucker uses digital photography and the image translation function of Google's Translate app to convert pages of the Canadian *Hansard* from English into French, and vice versa. The *Hansard* is the transcript of Parliamentary debates published in both official languages. The Canadian *Hansard* is an example of an English-French parallel text with roughly equivalent and aligned translations, making it ideal for use as training data in machine translation programs. *O/Ô* features translated pages of the *Hansard* from the day in 1980 that "O Canada/Ô Canada," another bilingual text, became the national anthem. The official English and French versions of "O Canada/Ô Canada" are somewhat different, so the anthem is considered bilingual, but not parallel. Furthermore, in the original French-language *Hansard*, the English-language lyrics of the anthem are not translated into French along with the rest of the transcript. Nevertheless, Google Translate makes an absolute mess of the lyrics, the French-to-English prose translations, and the resultant image, producing low-resolution collages of text comically inferior to the parallel translations (see figure 5). Personally, I am tickled by its revision of "Oh Canada, we stand on guard for thee" into "Oh Canada, toilet stand on guard for thee" (*O/Ô*).[17]

[17] Tucker and I published *O/Ô* via The Blasted Tree in 2018. When he first proposed the project, I was intrigued by the interplay between print and digital formats; he had photographed print copies of the *Hansard* using his smartphone, then saved screenshots of the translated text in Google Translate. I up-scaled these images as best I

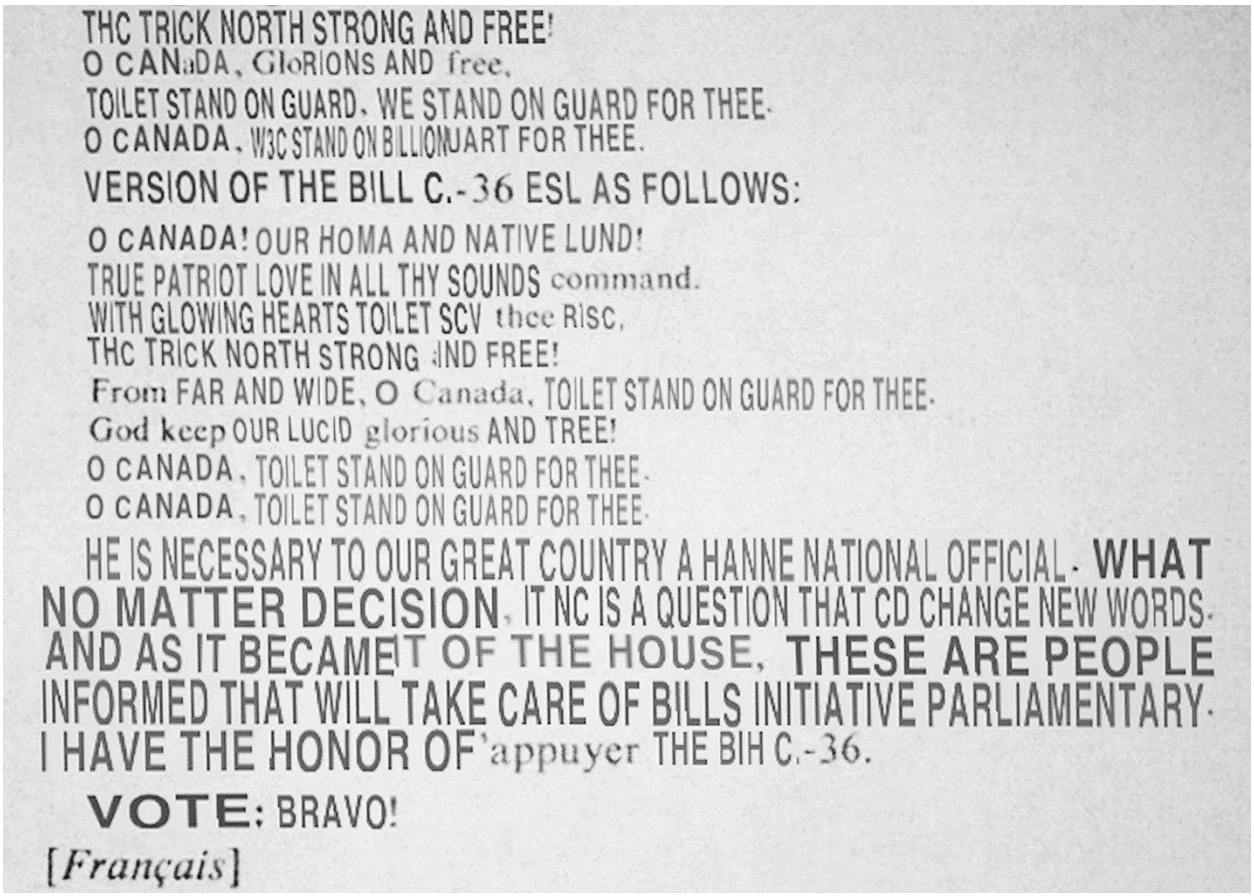

Figure 5. “French to English” from *O/Ô*, detail of broadside (Tucker).

The image translation function of Google Translate combines a variety of sophisticated digital tools into one not-quite-seamless application, including optical character recognition, machine translation, and automatic image processing. These tools rely on machine learning, a method of automating analytical processes. As with statistical models of language, machine learning systems sift through and extrapolate patterns from large amounts of training data, building a model against which to compare new data. Computers require massive datasets to train robust

could before printing them. *O/Ô* consists of two broadsides in a black file folder alongside a letter about the project under an official-looking Canadian government letterhead. The design apes the authority of government documents and the seriousness of the national archive.

translation systems, and programmers have turned to the internet and other public repositories of language to provide data for statistical analyses. Tucker chooses the Canadian *Hansard* because of its long history of use as training data for machine translation programs; this text participates in the history of colonial nation-building in more ways than one. English is the dominant language in the field of machine translation because centuries of colonialism and cultural imperialism have created an abundance of bilingual corpora where half of the text is in English. The sheer quantity of English on the internet reinforces this centrality, again due largely to the propagation of American-style technocapitalism. While there are other factors enabling the predominance of English, its commonality has even led to its use as a pivot language between other languages where insufficient data exists to perform a direct translation, which, as Poibeau points out, only leads to the re-inscription of English as a mediating language (166–8). With this context in mind, the comedic messiness of *O/Ô* takes on added significance, acquiring a dimension of critique; its crude translation and output image are suggestive of miscommunication, flawed nationalism, chaotic cultural politics, and the persistence of colonial problematics through equally flawed technologies.

I can't help but notice that, besides their shared critique of colonial language, both *O/Ô* and *Un/Inhabited* take an oppositional slash into their titles. These poems straddle a line between the two states implied by the slash, both either-or and both-at-once. To me, this slash invokes the many binary oppositions digital poetry simultaneously preserves and collapses: reader/writer, poem/code, hardware/software, print/online, and so on. Hayles pays close attention to the dissolution of boundary conditions, arguing in "Virtual Bodies" that digital technology breaks the one-to-one relationship between signifier and signified. Whereas pre-digital technologies of inscription leave physical traces as record, literally reprinting each letter every time it is needed, digital technologies can modify, replicate, rearrange, or erase data ad infinitum. Therefore, in

Hayles' view, the material history of a document, its connection to the labor required in both its making and preservation, are nullified by computer technologies. Text can now be replicated with such ease that any link between a physical mark and the labor it stood for is effectively severed. How quickly is a word-processed paragraph copied or erased? How many keystrokes did I make writing this study? These questions are hardly relevant, at least not with respect to any physical evidence provided by a born-digital document.

When we take hardware into consideration, we see the mistake in claiming that computers don't re-inscribe letters with each use. Computers perform their version of inscription at a speed many orders of magnitude faster, and on a much smaller scale, than do humans. The time and space it takes to store, retrieve, and alter data has been reduced so dramatically that, from a human perspective, the one-to-one connections between signifier and signified, between keystrokes and characters on screen, appear broken. However, we must understand that, from the computer's perspective, every operation at every level, from magnetic drive storage to display output, results from one-to-one causal chains built atop physical systems. The orderly functioning of the device depends upon it. Though we are accustomed to taking it for granted, I think we understand this fact on a subconscious level. As Hayles suggests, our bodies grasp the nuances and particularity of each medium before our minds can conceptualize the experience of difference. Much like the willing suspension of disbelief that we enact to enjoy the theater, we willingly suspend our critical awareness of the underlying hardware to better enjoy the software's higher-level functioning, and this lends signifiers the appearance of flickering. The processing speed of the computer may even augment our suspension of critical faculties, making it easier than ever for us to forget a poem's material contingencies.

Fortunately for digital poets, the mere illusion of flickering opens signifiers to an incomprehensible multiplicity of meanings. Hayles argues that the power of computers lies in their ability to nest chains of code; Montfort argues this as well with respect to object-oriented programing. In "Virtual Bodies," Hayles writes: "Acting as linguistic levers, the coding chains impart astonishing power to even very small changes" (77). Notice her use of "levers," a physical metaphor suggesting a causal chain of events, even though the transition between layers of machine code is precisely where Hayles feels the relationship between signifier and signified becomes arbitrary. So far as human users are concerned, yes, there is arbitrariness at each level of exchange, but it is crucial to note how the sheer speed and accuracy of computational processes operating on a strict cause and effect basis provokes the sense of severance at a higher conceptual level. The salient point is that we understand implicitly how text made available by screen or book will alter the experience of it, just as a trip made by plane or by foot will inform one's perception of an equidistant journey. As Hayles puts it, "I know kinesthetically as well as conceptually that the text can be manipulated in ways that would be impossible if it existed as a material object rather than a visual display" ("Virtual Bodies" 71). There's just no getting around the ways the physical attributes of different media influence our bodies, and therefore our minds. I say more on this in Part 2, where I investigate proprioception, the mind/body interface, and literature as an object of sensory perception.

Computer-Assisted Authorships

Digital poetry complicates the conceptual partition between human and computer authorship. It feels a little ambitious to claim that computers can write poetry, even at their present level of sophistication, given that they only perform what we have programmed them to do. On

the other hand, authors often surrender a degree of agency over the resultant text to the computer; the more sophisticated the automated decision-making, the more agency it appears to have. In the cases of both *Taroko Gorge* and *Pillage Laud*, computers select words from a lexicon supplied by the poet and/or programmer, then output semi-random combinations and permutations of text governed by a coded syntax. Hartman, author of the MacProse text generator (now called PyProse) that Moure used to compose *Pillage Laud*, explains its operation:

> First, the program builds a sentence tree by consulting its grammar file (PROSE.GRA), beginning with a randomly chosen rule for "Sentence." Then it chooses a random rule for each item within that initial "Sentence" rule that is defined by other rules in the grammar, and recursively for the items in that rule. Then it takes each "twig" -- each item in the tree that is not defined by a grammar rule -- and does one of two things with it. Either it randomly chooses an entry for the twig ("Noun," for example) in the dictionary file (PROSE.DIC); or it manufactures a word, for example by conjugating "to be" or "to have" in accord with any constraints the sentence has already established. The program also massages dictionary items, conjugating verbs and pluralizing nouns. (1–2)

Users of Hartman's program are able to edit both the grammar and dictionary files if they wish, though immense variability is already built in. The grammar randomization begins with one of twelve modifiable sentence templates. Syntax drawn from dozens of subordinate sentence structures fills each part of the template. One relatively short example might be:

```
Sentence
    Question
        ->AuxVerb
        NounPhrase
            ->Substance
        ->IntransInf
    ->@?
```

MacProse draws words at random from a dictionary file organized into parts of speech categories thousands of entries long, populating the grammatically-correct sentence templates with them. The example structure above produces sentence like:

Would folklore flow?

Shall honor rash?

Can tooth insist?

The number of potential sentences that this program could generate is astronomical, and though not every line produced makes semantic sense, its output is considerably more readable than the image translation that Tucker made of the *Hansard*.

With respect to her method of composition, I'm not sure what Moure means by "pulling through certain found vocabularies, relying on context" besides the exertion of authorial influence on the output of Hartman's program (5). Perhaps she modifies the dictionary or grammar files before generating content for *Pillage Laud*. Perhaps she draws sentences from the raw output which include or are proximate to her "found vocabularies." Perhaps she selects output through an associative logic all her own. Regardless, she sculpts the program's output into poetry by rearranging lines, introducing lineation and stanza breaks, italicizing words for emphasis, and so on. Moure transforms the text from a programmatic determination of linguistic potentials into a poetic configuration of text inflected through her artistic sensibilities and intentions. The publication of *Pillage Laud* in print solidifies this configuration, but it does not definitively settle the question of authorship. Who is the author of this text, and whose influence most determines its meaning? My impression is that Hartman, Moure, and Moure's computer all play critical roles in constructing the poem, and thus co-author it. However, the massive output potential of the MacProse system necessitates a human agent to craft its sentences into something recognizable as

poetry. Moure's human agency therefore makes possible the conceptual space of the poem as she crafts, through word choice and poetic license, an otherwise computer-generated text.

Taroko Gorge also draws upon a prescribed lexicon and syntax to generate lines of poetry, though Montfort does not edit the program's output. Instead, the poem generates anew each time its looping code executes. Marino describes how it operates:

> *Taroko Gorge* produces an endless stream of poetry, following a consistent set of randomized patterns. The basic pattern offers a path (noun + verb + object), followed by zero-to-two sites (noun + verb), another path, and a cave (verb + the + noun + adjective + object). The pattern is roughly ABBA-C, with some additional Bs on occasion. The lines of poetry continue to scroll until the program is stopped. (202)

Where Hartman provides dozens of possible syntax rules and thousands of words for the computer to choose from, Montfort programs in a very limited set of patterns and only a handful of words. The whole program, comments and lexicon included, occupies only 65 lines of code. *Taroko Gorge* generates a new version of the poem each time it runs, so "[n]o single poem produced by these generators," Marino writes, "can truly sum them up. For that, one needs to have the code. At that point, the algorithm becomes the poetry," or at least a key part of it (208). Montfort often publishes the source code alongside print versions of his poetry. This code gives readers an appreciation for other possible versions of the poem, or an idea of how the poem might unfold in a digital environment.

To illustrate, let's look at a section of Montfort's code. Lines 33 to 40 of *Taroko Gorge* define a function that determines the cave scene in the ABBA-C pattern described above:

```
33. def cave():
34.     j=['encompassing',c(x('rough,fine'))]+\
35.     x('sinuous,straight,objective,arched,cool,clear,
            dim,driven')
36.     t=c([1,2,3,4])
```

```
37.     while len(j)>t:
38.         j.remove(c(j))
39.     v=' '+c(x('track,shade,translate,stamp,progress
            through,direct,run,enter'))
40. return v+' the '+' '.join(j)
.................................
64.         p(cave()+' --')
```

First, the program stores a list of ten adjectives in an array called ‘j’ that includes either “rough” or “fine” but not both. It prunes the array at random until there are between one and four entries remaining, a length also chosen at random. In line 39, the computer selects a verb from a list of eight words, appends it to a blank space, then stores it in the variable ‘v’. The function combines ‘v’ and ‘j’ in line 40 and returns the combination when the ‘cave( )’ function is called. This occurs in line 64, which prints text returned by the function followed by “ --.” Some lines this function is capable of producing:

stamp the clear driven --

translate the rough straight cool --

run the encompassing fine objective arched --

Despite its ever-changing output, the limited lexicon and line structure of *Taroko Gorge* lends the poetry a consistent tone and flow. Rather than curate the program’s output, as Moure does, Montfort asserts his authorial influence at the level of the code itself. The program repeats words in slightly modified configurations, giving the poem a regulated, meditative feel. Its tightly constrained pattern of scenes, cycling through paths, sites, and caves, evokes strolling through a natural setting, discovering unique vignettes in an otherwise cohesive environment. Though the computer assembles lines of poetry during runtime, Montfort has carefully curated their contents and arrangement into scenes in advance. The source code of *Taroko Gorge* is publicly available, and Montfort encourages readers to exert their own influence on the program’s output by making

alterations, spawning many spinoff poem generators.[18] Though computer mediation comes at different stages in their work, both Montfort and Moure surrender a degree of their own agency to automated processes.

In the preceding examples of text generation, the user has access to and can modify both the lexicon and syntax rules structuring the program's output. The same is not true of Google Translate, which Tucker applies to the Canadian *Hansard*. Not only are Google's datasets and translation algorithms proprietary, but machine learning systems—commonly referred to as deep learning or neural network systems—are notoriously opaque to human users unless they are designed to make explicit their decision-making criteria. Poibeau writes: "[I]t is hard to understand and analyze the way a neural system works, since the internal representation of the data is purely numerical, huge and complex, and more importantly not directly readable by a human being" (193). Translating poetry into a language illegible to human readers invests the machine with a higher degree of mediating agency than, say, Montfort's tightly constrained poetry generator. Google Translate makes a substantial number of decisions without the possibility for user intervention. Many of Tucker's digital poetry projects, including *O/Ô*, involve a computational act of intersemiotic translation, i.e., the translation of a text from one symbol system into another. "[A]n intersemiotic translation," Tucker claims, "does not replicate but rather adjusts or re-presents a source text in some new form" ("Machine Co-Authorship(s)" 9). If we are to understand intersemiotic translation as producing new texts, then we can attribute at least partial authorship of those new texts to computer programs. Tucker uses the term 'human-machine co-authorship' to describe this manner of investing the machine with determinative agency over his creative work.

[18] Marino covers several derivative versions in *Critical Code Studies*, including Rettberg's *Tokyo Garage* (2009) and *Gorge* (2010) by JR Carpenter. See "Generative Code" in *Critical Code Studies* for a survey of spinoff poems.

Recall that Tucker advocates a critical posthumanism cleaving to "an enlarged sense of inter-connection between self and others, including the non-human or 'earth' others" ("Machine Co-Authorships" 7). Critical posthumanism is prepared to treat non-human agency as a meaningful contribution to poetic craft without making value judgements about the degree of computer mediation in a work.

Of course, it's not so much the computer's agency that makes something digital poetry as it is the human directing it, framing or otherwise crafting the text into a poem. This can be said for all the examples covered in Part 1 so far, from Moure's curation of MacProse output to Abel's manipulation of KWIC search results, Montfort's controlled text generation to Tucker's chaotic image translations. Without the context of Tucker's posthumanist creative practice, for instance, the images of the *Hansard* produced by Google Translate would remain comical gibberish. This accords well with the point Burckhardt and Höfer make about the value that human activity adds to computational systems, namely: activities "eluding the logic of formula" (39). Human co-authors of digital poetry reframe the logic of formula as creative expression, just as their computer counterparts reframe creative expression in the logic of formula. When Spinosa critiques the Conceptualist fetish for human procedural labor, she is critiquing the failure of digital-era poets to find ways of adding value to computational processes that might more easily be executed with a machine. Not only is their human labor unnecessary, it denies the posthuman reality of human-machine co-authorship. As human-computer interactions reach higher levels of complexity, the question becomes how the discrete qualities of human and computer agencies come together to produce each particular poem.

Code Imitating Life

To conclude this chapter, I want to discuss a digital poem involving many operations of reciprocal mediation between human beings and machines, analyzing how the parameters of each medium contribute to the artistic space defined by the poem at hand. I've chosen to include *The Sims in Real Life* by Robinson in this study, a poem published by my own small press in 2019, because the first-hand experience of publishing a work straddling the analog/digital divide has been indispensable in forming my thoughts on digital poetry. Robinson and I produced *The Sims in Real Life* in a limited edition of transmedial chapbooks comprised by a printed booklet featuring the poem and a CD pre-loaded with bonus digital content—including an introduction by the author, an editor's note, video and audio files, production images, and more—all presented in a jewel case reminiscent of a '90s-era PC video game. *The Sims in Real Life* offers a peculiar image of humanity reflected in technology, and vice versa. Robinson's work alerts me to the ongoing and entrenched reality of posthumanism as it exists, not just in theory, but in my own life. The reciprocal exchanges between people and digital technologies constitute an entire way of being. *The Sims in Real Life* incorporates many kinds of media and invokes multiple human and machine co-authors; to my mind, Robinson's poem is as much about transmediality as it is about the words on the page. Because of this, *The Sims in Real Life* illustrates many of the challenges that digital poetry presents to the established norms of publication and literary criticism.

The Sims in Real Life is a transmedial project taking text generated by *YouTube*'s automatic captioning function and turning it into poetry. The function's speech recognition and subtitling abilities involve a range of technologies working together to interpret and transcribe verbal input, from automatic audio and natural language processors to deep learning neural networks and predictive algorithms. Accurate auto-captioning is something of a modern computing miracle,

though *YouTube*'s systems are still far from foolproof. Robinson has found several examples of auto-captioning applied to *YouTube* videos wherein the software mistakes verbal gibberish for speech, generating English captions from nonsensical sounds. Like Moure, Robinson edits and reframes his computer-generated text to have the structure and flow of a poem. As he says in the introduction to the project, this text is "part found poem, part translation," and though he makes the occasional tweak for clarity, his is "an editorial role as opposed to a generative one."

Robinson has subjected several auto-captioned *YouTube* videos featuring gibberish to poetic intervention, but *The Sims in Real Life* is derived from one in particular: "Sims in real life Prank" uploaded to the LETZUPLOADIT channel. This video features a prankster interacting with people on the street, confusing them by imitating the comical mannerisms and speech patterns of characters from *The Sims*, a popular series of life simulation video games first released in 2000. *The Sims* is a virtual dollhouse, a sandbox game without goal-oriented narratives. Instead, characters simulate the daily lives of ordinary people. Their speech and gestures are caricatures of human mannerisms, conveying their thoughts and feelings through body language and the gibberish language Simlish. Simlish is the language that the LETZUPLOADIT prankster imitates, and which *YouTube* attempts to translate into English. My editor's note, included in the bonus content of *The Sims in Real Life*, makes a good jumping off point for further comment:

> While the concept of using written material generated by a computer from nonsensical human sounds is brilliant on its own merit, I found special delight in this particular iteration of Robinson's work. The prankster in the video chosen for source material for *The Sims in Real Life* imitates video game characters who are in turn simulations of everyday human beings. He speaks and gesticulates like these humanoid Sims, but cannot be understood by the real people the game purports to emulate. And yet, a computer program succeeds where

> his prank victims fail, re-inscribing meaning on the prankster's apparently meaningless words. This back and forth movement—art imitating life imitating art imitating life—is mediated by language, or rather an overlapping series of languages flexible enough to accommodate "translation" from one medium to the next.

Here I'm thinking not only of human language, but the various layers of machine language mediating the translation from spoken pseudo-Simlish into English text. I suppose translation is contestable as the best word to designate all the processes I mean to invoke: recode, convert, transcribe, and remediate also touch on it. Tucker addresses the imprecision of these terms in "Machine Co-authorship(s)," suggesting that "the act of translation is defined by its interpretive transformation whereas recoding and remediation do not to the [same] degree" (9). Translation also retains the suggestion of a natural language as the source or target language of the text, implying a human subject at some point in the interpretive process.

The recursive aspect of *The Sims in Real Life* strikes me as interrogating what we think of as human. Noam Chomsky and other linguists argue that a non-evolved cognitive device is embedded in the human mind, a set of core cognitive mechanisms they called the 'narrow language faculty' granting quintessential human capacities for linguistic recursion and rule-governed creativity (Harpham 109–10). In *I Am a Strange Loop*, Douglas Hofstadter also argues for an embedded mechanism leading to higher-order cognitive functions, including our unusually keen sense of self-awareness. For Hofstadter, recursive awareness does not belong to humans alone; other creatures have it, and human intelligence is only a matter of developmental degree. Harpham characterizes the idea of an embedded cognitive device as a posthuman return to a mechanism at the heart of human identity (110–11), a position I expand on in Part 2.

Deep learning neural networks, such as the one supporting *YouTube*'s auto-captioning function, also make use of recursion. To what extent recursion connotes self-awareness, as Hofstadter suggests, I do not know, but it raises questions about the line between human and artificial intelligence (AI). With respect to digital poetry, the possibility for self-aware AI feeds into a persistent anxiety about how it might encroach on a uniquely human form of creative expression. Returning to my editor's note:

> Entangled in all of this are questions of authority, intertextuality, and originality. Who is the [...] author of this poem[:] the gibbering YouTuber, the auto-captioning function, the programmers behind that function, or Robinson, who 'found' the text and thought to frame it as poetry? Which is the official version[:] the captions as produced by *YouTube*'s proprietary software, the edited text reprinted in the booklet, burned to [the] CD, or embedded on The Blasted Tree's website, or is it the audio stream from the original video, the text-to-speech recordings we made from the text, or the master files from which I printed the project?
>
> I don't have definitive answers to those questions. My inclinations may lead me to conceive of *The Sims in Real Life* differently than Robinson, the conductor of this strange symphony, who may approach it with a set of priorities different from the prankster's, the *YouTube* programmers', or the game developers', who are all entrenched in the making of the poem, whether they know it or not. [The] multimedia chapbook does not encompass or contain the entirety of *The Sims in Real Life*; rather, it gestures toward a conceptual space where a set of people, programs, languages, and materials from disparate times and places all come together to perform the generative act of the poem.

My position echoes something of Roland Barthes' concept of the reader as the ideal addressee or destination of the work, more of a position in relation to the text than a particular person. In "The Death of the Author" he writes: "The reader is the space on which all the quotations that make up a writing are inscribed without any of them being lost; a text's unity lies not in its origin but in its destination" (1325).[19] The destination of a work, this ideal reader, holds together all the multiple writings and intertextual relations that make up the text itself. Barthes contends this reader must be an impersonal someone, a field or function "without history, biography, [or] psychology" (1325). Would that not make computers the most ideal readers of digital poetry like *The Sims in Real Life*? Do machines not hold together all the digital assets comprising the poem? Perhaps computers do not 'read' in the Barthesian sense, but they do seem to make ideal destinations for textual unity. Unlike Barthes, I'm not interested in theorizing an ideal readership, as I argue for a community of historically-situated readers with unique lived experiences and psychologies. Rather, I'm interested in how the composite space of the poem interfaces with individual human subjectivities to produce a multiplicity of readings. It may be that questions about authorship, ideal readers, and authorial texts can only be answered in relation to one another.

Looking back on the definitions of digital poetry summarized in Part 1, it's easy to see how overdetermined categorical schema cannot account for the transmedial aspects of *The Sims in Real Life*. The poem exists as a subtitled video, as screenshots of that video, as the copied text of the subtitles, as text-to-speech audio of those subtitles, as data stored to compact disks and hard drives and zipped on a website's server, and, finally, as printed in the CD's liner notes. Its incarnation in print is only one of the several forms the project wears. The richness of *The Sims in Real Life* is generated by the interplay between these various formats. Viewing everything but the printed-and-

[19] Barthes' view of a text's ideal destination recalls Solnit, Coady, and Borsuk on books as seeds or potentials that readers' minds activate. See Part 1, "The Digital Revolution/Apocalypse."

bound version of a poem as ancillary or supplemental does not characterize the reality of future-facing digital poetics offering complementary readings in digital and analog media. Flores put forward a sliding scale classification system at the ELO conference in 2016 in an effort to make the ELO's definition of electronic literature more adaptive to emergent technologies and creative practices. He proposes considering six categories to evaluate if and to what degree a work counts as electronic literature. For instance, one category ranks a work's level of network sophistication from "none/offline" to "used in process" to "vital to reception," suggesting that literature requiring network connectivity for reception is more valid as e-lit than work composed, distributed, or operated offline (qtd. in Spinosa, "Toward a Theory of Canadian Digital Poetics" 237).

While I agree with Flores about the importance of situating the various parameters of computer mediation on a spectrum, I reject progressivist valuations of technological sophistication that discount transmedial literary artifacts in favor of pure digitalism. Jessica Pressman highlights that "reading and writing about-and-with digital technologies involves a constant agonizing over value judgements surrounding what forms of reading and writing matter" (qtd. in Cutting). This agonizing stems from the different privileges engendered by technological mediation. I argue these differences are unavoidable and emerge naturally from the incompatibility of diverse and successive media formats. As I have demonstrated with respect to *The Sims in Real Life* and other poems addressed in Part 1, digitalism challenges the conventions established by pre-digital literary criticism. Transmedial creative practices defy categorical boundaries in producing literary artifacts with multiple versions, authorships, and signifying features beyond the text itself. Some digital practices engage with computation at the production stage, others in reception. Some encourage meaningful feedback integration, others passive viewership. Thinking of digital poetry as a

composite of transmedial facets exhibiting the potentials of computational power while subject to its costs and limits allows for the analysis of literary texts from the broadest possible perspective.

Anna Munster describes the relationships between humans and technology as "open-ended propositions," meaning scholars don't have to settle on one explanation of how human and virtual bodies interact to conduct literary criticism on digital poetry (*Materializing New Media* 13). From this perspective, critical discourse unfolds alongside each new experience of a creative text. I'm reminded of Lisa Samuels and Jerome McGann's argument in "Deformance and Interpretation" that any discourse on a poem constitutes not an appendix to the creative work but a performance or creative work in its own right. Therefore, 'deformance'—i.e., any change to the original text in its representation in discourse, adaptation, or remediation (which is, of course, unavoidable)—does not create conflicting interpretations of a text, but uncovers how it is possible that various interpretations can all be functions of the same text. To me, readers in the cybernetic milieu do not glean one interpretation from the printed page, one from the source code, and another from the screen and stop there; they grapple with how page, code, and screen co-constitute the larger poetic project. In the next chapter, I turn to the material qualities of various reading interfaces and the influence of digital materiality on the experience of digital poetry.

Part 2 – Composite Materials

Prior to the creative writing workshops I attended during my undergraduate studies in Montreal, I thought of reading and writing as solitary acts, conducted in the private space between a person and a page. I assumed that literary studies would be a field of introverts, everyone with their nose in a book or working fervently on their own writing projects. It didn't take long to realize how wrong I was, and that my writing, both critical and creative, would not make it far without help from generous readers willing to see it through its infancy. These readers—other students, instructors, and friends—became my first literary community, and I was grateful for it, though I may have taken for granted that it would continue to grow. In 2016, when I finished my degree and moved back to Calgary, I was forced to confront the sudden absence of this community, a lack I had never noticed in my creative life before. It turns out that camaraderie, discourse, and mutual support are essential features of a sustainable writing practice, and no writing exists in a vacuum or should be considered in isolation. So, for a time, I missed having like-minded people to talk with about poetry, and my own work suffered.

That all changed when I was introduced to derek beaulieu at a University of Calgary event later that year. beaulieu is an educator and the current poet laureate of Banff, and I immediately gravitated toward his approach both to visual poetry and to small press publishing. He encourages poets to circulate their work widely and in as inexpensive a format as possible. He also encourages people to adapt, experiment with, remix, or otherwise innovate on his work.[20] beaulieu's publishing philosophy complements his writing practice, which emphasizes the intersection of conceptual and visual poetry techniques. His collection *fractal economies* incorporates many

[20] Much of beaulieu's poetry is available for download from his personal website, derekbeaulieu.ca. He runs No Press and advocates for a circulation-over-profit publishing philosophy. I have found this philosophy contagious, and we maintain a trade relationship between our small presses.

inscription methods, from dry transfer lettering and photocopying to frottage and collage, while the afterword presents beaulieu's thoughts on contemporary concrete poetry: "I propose a poetic where the author-function is fulfilled both by the biological 'author' of the text and the technology by which it is created" (83). beaulieu advocates for a poetics of glitch informed by the limitations of the physical method of inscription. Dry transfer lettering, for instance, is prone to cracking and other imperfections, so he uses crumbling letterforms to convey the fragility and ephemerality of the medium. Conversations with beaulieu have led to my own experiments in visual poetry motivated by materials and process, and the research questions pursued in Part 2 of this study follow on this line of thinking about literary materiality. Concrete poetry prompts me to ask: what are we actually interacting with when we read a poem? How do physical materials, tools, and techniques contribute to the apprehension and interpretation of digital poetry? How might readers respond to the seemingly paradoxical notion of digital materiality?

Let's begin by unpacking the term 'materiality'. In the preceding chapter, I treated mediation primarily as it occurs between two or more languages—English and French, natural and machine, higher- and lower-level, etc.—but mediation also connotes the physical medium of expression, and the transmission from one set of materials into another, as when print books are digitized, light rays expose photochemical film, or electrical impulses drive a speaker to make soundwaves. Following McLuhan, I recognize the impact of the medium of transmission on the message, adding that this impact is due largely to the way each medium physically interacts with the human sensorium by way of its material composition. The affective qualities of a text's material instantiation are what I mean by its materiality—a definition, Munster points out, that captures both physical and sociohistorical valences. Munster distinguishes between two overarching ways that critics use 'materiality' with reference to digital technologies; on one hand, it means the

physicality of the hardware, user interface, and computational processes, and on the other, it refers to the real-world conditions under which digital poetry is produced and consumed, including social relations, political contexts, and so forth ("Materiality"). This means, for example, that both technical parameters, like the brightness and resolution of display hardware, and the wider psychosocial conditions of screen usage contribute to the materiality of text presented on a screen.

Despite its frequent association with pre-digital concrete poetics, the material attributes of digital poetry were not commonly discussed until the early 2000s, which Munster identifies as the "material turn" in digital literary criticism ("Materiality"). Many critics argued that virtuality would sweep away material considerations until Hayles, Johanna Drucker, and other media theorists brought attention to the persistent physicality of digital media and the connection between immediate materials and worldly concerns. "[A] materialist approach," writes Munster, "is a transdisciplinary means of connecting the digital to social relations and historical practices;" scholarship on the materiality of digital media must therefore account for "the ways it transduces and interrelates its multiple, proliferating levels of hardware, software, data, and social practices" ("Materiality"). This last factor explains the plasticity of the book as a concept, particularly in its accommodation of transmedial work, and how digital poetry, with its close attention to the medium of expression, emphasizes the human/computer interface. I elaborate on the interface theories of Hayles, Lori Emerson, and others throughout Part 2, especially insofar as ubiquitous interface design and the black box operations they conceal are obstacles to creativity.

In Gibson's brief introduction to *Transdisciplinary Digital Art*, he distinguishes between trans- and interdisciplinary artwork and gestures to the different skill sets transmedial creative practices bring together. "Interdisciplinary," explains Gibson, connotes separate disciplines "performing their own expert functions without more thorough knowledge of the other's technical

or artistic processes" (1). Consider a Hollywood film, with its various actors, editors, stage technicians, musicians, and so on, each with their own specialized role in the film's production. Film itself may be a discrete medium, but the creation of a film takes interdisciplinary effort. "Transdisciplinarity," on the other hand, "implies a level of direct connection and cross-over between mediums: the artist becomes the engineer, the engineer becomes the artist, and when they collaborate they actually have enough expertise in the other's field to be able to address concerns across the mediums and even across disciplines" (Gibson 1). For several of the 3D-printed poems I cover in this chapter, the poet has collaborated with a computer scientist to remediate an existing text-based poem into a three-dimensional model. There are several configurations of interdisciplinary collaboration evident in these cases, from a poet bringing their idea to a person capable of executing it for them, to a poet learning and implementing techniques from various disciplines themselves. The latter situation combines the artist and software engineer in one person—from a transdisciplinary standpoint, this unification is ideal—but it is more difficult to achieve on a practical level. As Ted Underwood puts it, the combination of literature and computer science "is not limited by the conscious opinions of scholars, but by their training."

The unlikelihood that the average poet is also a computational polymath means there are understandable limits to the unification of various fields in individual practitioners. I have certainly encountered this stumbling block in my own critical and creative undertakings. At very least, Gibson claims, "transdisciplinary art […] makes the *effort* to understand the medium of the *other* in more than superficial terms" (1, emphasis Gibson's). Transdisciplinarity, to me, implies more than an effort to understand the media involved, and more than the harmonious collaboration and exchange of skills between specialists from different fields. For art to be transdisciplinary, it must own its status as transmedial, exploiting or even relying upon the interstitial spaces formed by

incomplete translation between media, as do Robinson's *The Sims in Real Life* and Tucker's *O/Ô*. I am reminded of the physical property of refraction, the bending of a wave as it passes from one medium into another of a different density (light passing from air into water, for example). Refraction is an obstacle for or at least incidental to intermedial art. We find it where feature-length film adaptations omit details from the book, or when a website is not optimized for display on smartphone screens. Transmediality, on the other hand, explores, embraces, and makes an art of its transit through dissimilar media and their various materials. From this perspective, we notice that *The Sims in Real Life* is not only a remediation, it is about remediation. Similarly, *Loss Sets* is very much about what is lost in translation from one medium to another, and it wears this loss in the structure of its physical form. All this to say, it is the trans- rather than intermedial aspects I find myself drawn to when considering the materiality of a digital poem.

On Digital Materiality

Just as there is debate over the boundaries of digital poetry as a literary category, critics harbor wildly different ideas about what to regard as its materials. Does the physical presence of digital poetry reside in computer hardware? In the parameters of the software it runs upon? Perhaps in its approximation of pre-digital communications technologies? Literary critics offer many competing theories, but they tend to agree that materials are of great concern when it comes to analyzing digital poetry. From foundational thinkers in the field like Glazier and Hayles to contemporary scholars including Schaefer and O'Sullivan, materiality is seen to structure our readings of digital texts. I propose that if a poem refers to the unique conceptual space defined by the parameters of the text itself, as O'Sullivan argues, its materials are the various components which enter into that space. And yet, there is a two-way flow of influence between a poem's conceptual and physical materials. How we perceive the conceptual space of the poem—i.e., which

of its dimensions are found to contribute meaningfully—has an effect on how we perceive its materials. The reverse is also true; the materials a poet uses, and how they are arranged, tends to inform our conception of the space they occupy.

As with the interpretation of a poem's semantic content, there is an unavoidable degree of subjectivity in deciding which components contribute to its materiality. If materials are the starting point from which critics usually set out to distinguish digital poetry from its predecessors, they are also the point at which critics diverge and implement conflicting definitions suitable to their various conceptual frameworks. Hayles, for instance, is interested in how human bodies interact with literary texts, defining materiality at the level of input/output hardware like the mouse, keyboard, and display screen. Meanwhile, Glazier looks to software and the graphical user interface (GUI), extending digital materiality to include parameters like window size and navigation style. These two forms of materiality work in concert—users move a physical mouse with their hand to interact with navigational cues on screen—so I do not interrogate which of these versions is correct, or through which medium or at what level I should define the material conditions of my domain of inquiry; rather, I attend to the dynamics that different media exhibit when they are used in tandem. This section outlines a robust and adaptive theory of digital materiality which can be applied to the variegated domain of transmedial poetry.

To come to grips with a theory of materiality, we shall first review how it has been conceived of thus far. One opinion, the earliest proposed of those I survey here, takes hardware, and nothing else, as material. In an essay provocatively titled "There is No Software," Friedrich Kittler claims that every function a computer performs can be reduced to physical operations, referring to the many ways hardware like BIOS chips, logic switches, disk drives, and LED displays govern the higher-level expression of software and file content. Moreover, he argues that

computers are designed to conceal their internal operations, so the average person takes them for granted. Kittler writes: “Perfect graphic user interfaces, since they dispense with writing itself, hide a whole machine from [their] users.” This view of materiality foregrounds the preeminence of hardware and the alienation of readers from the technical workings of digital content.

Glazier, on the other hand, argues that parameters like metadata, window size, and navigation style exert more influence on the experience of reading digital poetry than the underlying hardware. Where Kittler urges us to consider the device and the physical laws governing its functions, Glazier directs our attention to the capabilities and constraints of the software with which readers interact, claiming these features as the true substance of digital poetry. His central argument in *Digital Poetics* is that computers expand the material possibilities for making poetry, a development necessitating the redefinition of writing itself. Given that the semantic content of a digital poem might be indistinguishable from that of a pre-digital poem, Glazier’s premise is that digital poetics are not just or even mainly about writing, but about how writing is made, distributed, and read. His sense of digital materiality is located squarely in the mechanics of the GUI, in functions like hypertext markup, application windowing, copy/paste, find and replace, directional scrolling, and so on. These functions determine how users navigate text in digital environments, thereby influencing the path of reading and writing. The immediacy of the information that GUIs present to a reader’s senses determines the tracking of their eyes, and thus their movement through text, much more tangibly than do circuit boards. However, as Glazier points out, all poetics engage with system as a determinative factor, be it rhythm, constraint, or code—in a sense poetics are just systems applied to symbols—though he suggests that digital poetry may be a special case of “a public word, projected across a public world, across systems,

itself a system" (38). This is a fascinating comment on the cybernetic milieu digital poetry circulates within, and a subject I return to in Part 3.

Like Kittler, Glazier considers what is hidden from the reader, prompting critics to examine the code, metadata, and software settings of every application studied. He writes: "One should not consent to protocols, default settings, interface design without question. Such parameters of online reading and writing, like the formatting of 'the book,' do not serve as transparent conveyance for meaning" (18). As Hayles, Borsuk, and others remark about the printed book object, choices poets make about digital media have profound effects on the ways readers access the text, and subsequently on their interpretations of it. Thus, Glazier compels readers to question every aspect of the digital poem and the software delivering it—from surface features like user input fields to hidden aspects like source code annotations—while remaining open to those aspects that are particular to digital media. Readers of digital texts may treat pop-up windows, animated text, hyperlinked images, and so on as potentially significant, as we already do a printed book's length, paper quality, and cover imagery. Glazier thus foregrounds how the parameters of software both facilitate poetic contents and structure their interpretation.

Hayles resolves the tension between hardware- and software-focused approaches, adding a third element into the mix of material considerations: the human user. Hayles is interested in how living bodies interact with literary texts and defines materiality as the intersection of hardware, software, and user experience. In *Writing Machines*, Hayles also argues that to change the physical form of a text is to go beyond merely changing the reading experience, it is to "transform the metaphoric network structuring the relation of word to world" (23). The interaction of a reader's mind/body—Hayles' term—with the physical device mediating the poem structures their perception of the text. This argument moves beyond an insistence on either hardware or software

alone to highlight the generative exchanges taking place between the device, program, and user. Hayles thus advocates for a critical method she calls media-specific analysis attending to how the "material apparatus produc[es] the literary work as [a] physical artifact" addressed to reader's bodies (*Writing Machines* 29). As with other modes of literary criticism, media-specific analysis accounts for how readers and texts come together to produce meaning, yet it also acknowledges the subconscious spatial relationship between the reader's body and the poem.

I was aware of the many ways our bodies conduct themselves subconsciously through space and with respect to matter before reading *Writing Machines*, but I had not conceived of them as belonging to a coherent sixth sense, proprioception, nor did I anticipate how this sense informs the reception of literary content. Proprioception involves several interrelated abilities: balance is sensed by the vestibular system in the inner ear, extremities swing to reorient while falling, muscles tense in anticipation of a load, and so on. According to Hayles, proprioception is a major contributor to the sensory experience activating material metaphors in the mind of the reader. Imagine reading from a heavy hardcover book indoors on a rainy day versus from a mass market paperback outside in the sun, and how these environmental and material factors feed into our understanding of the work at hand.

The term materiality thus acquires a new and specific valence in *Writing Machines*. Given the interchangeability of the polymers, circuits, and components making up a device, and the potentially infinite combination of binary operations driving it, neither hardware nor software determine the materiality of a digital poem; rather, a poem's materiality emerges from the interplay of hardware and software with artistic strategy. "For this reason," Hayles argued, "materiality cannot be specified in advance, as if it preexisted the specificity of the work" (*Writing Machines* 33). Just as identical poems delivered through different media engage in distinct modes of

signification, different poems instantiated though identical means will exhibit differing material qualities. Furthermore, readers construct their sense of a poem's materiality retroactively, or, at earliest, during the reading process, a principle interface theorists often remark upon, including Borsuk, as mentioned earlier, and Emerson, who we turn to in a subsequent section. This is significant in that poets cannot know the material specificity of their work until it is produced. To return to the example of the 3D-printed poem, try as one might to interpolate its physical presence from a digital model, it's impossible to know the actual look and feel of the object until you hold it in hand. An artist may have a good idea of how things will go, but, as Hayles would have it, in the end, a literary object's materiality exists in the experience of the beholder.

Given the preceding views on materiality, it appears that the conceptual space of a digital poem and its material composition are more than inextricably linked: they are co-constitutive and reciprocally informative. This link is recognizable in physical art forms like architecture and sculpture, but it is equally foundational in poetry. O'Sullivan, following Hayles, agrees that medium is a metaphor relating material to content, arguing that "[e]lectronic literature exploits the tension between these levels, so that technical processes create meaning in relation to cultural forms," and vice versa (96). For O'Sullivan, delivery via an electronic medium inflects the content of the poem in an essential way, though this inflection does not constitute the message of the work in the McLuhanian sense. Rather, hardware and software acquire materiality in relation to cultural forms. Both the physical size of a screen and the user interface it displays inform readings of digital poetry. Digital materiality thus refers to all the physical and conceptual elements structuring our readings of a poem, encompassing hardware, software, environmental, social, and personal factors.

The Atoms of Language

Binary code, as computers process it, is illegible to human readers, yet these electrical signals are as viable a form of human communication as poetry. Marino argues that "[binary] signals are a material form of communication, no less meaningful by their lack of additional symbolic representation. It is not the representational symbols that qualify code as language, but the system that allows us to use them in meaningful ways" (196). Computers mediate this subterranean language of 1s and 0s below users' awareness. Interestingly, artists oftentimes find computers most generative for creative pursuits at the limits of the predictable application of code, where breakdowns and surprises occur. Recall Robinson's *The Sims in Real Life*, which versifies text generated by an auto-captioning algorithm mistaking gibberish for human speech, and Tucker's *O/Ô*, presenting comically erroneous image translations of Canadian Parliamentary debates as visual poetry. Both rely on 'mistakes' generated at the interface of analog and digital technologies, tapping into what beaulieu describes as the "libidinal excess" of machine-based techniques (85). "By embracing the poetics of glitch—the mistake beyond 'human error'—we assign the generative space of the minimal swerve or error to a process-based poetics, where the process and the product are controlled by the device, and not the author" (beaulieu 88). I extend beaulieu's materialist foundation to digital poetics, arguing that unpredictability and glitch work in favor of embodied poetic expression and against artless calculation and the logic of formula by returning readers' attention to the fallible operations of the software and hardware supporting digital texts. Language is already a hodgepodge of conceptual and material components manifesting in a variety of media: in letterforms and on inscription surfaces, in sound and braille, through loanwords and pidgin languages, and so on. Rather than overwrite this hodgepodge, digital texts can only add to it. Conventional concerns take on additional dynamics; for instance, digital

distribution models have substantially changed the question of how many copies of a book to print and put into circulation. Each format has pros and cons which do not invalidate the advantages of the other, which is to say that digital and analog production methods are not necessarily at odds and can be made to work in concert.

To illustrate, take the case of *Assembled Lines* by Eric Schmaltz, a series of print-based visual poems which evolve through several iterations to become 3D-printed object poems. The project appears in print as "Assembly Line" in Schmaltz's book *Surfaces*, released in April 2018. Each poem consists of a single word, its individual letters disassembled and reassembled in a three-step process. First, the source word is broken into line segments representative of the strokes needed to write each letter: M is a single 'M'-shaped line; A is broken into two segments, an inverted 'V' and a horizontal crossbar '–'; E becomes a vertical '|' and three horizontal '–' segments, and so forth. Each segment is inventoried, grouped with its like, and arranged in descending order of size. Finally, line segments are diagrammatically recombined to form a single assemblage of partial letterforms (see figure 6). These poems mimic the instruction manuals accompanying Ikea ready-to-assemble furniture and Lego toy brick sets by enumerating the available components alongside visual directions for assembly. As assembly manuals are typically composed in a simple pictorial language, they are legible to sighted people from many cultural and linguistic backgrounds, meaning the operation of sense-making from a jumble of component pieces can be accomplished without the need for written words. Schmaltz plays with this to show how the components of written language, specifically the Latin alphabet, can be broken down and recombined to signify meaning without the necessity of comprehending the source word or language. "Assembly Line" conveys meaning despite the breakdown of its semantic units into asemic line segments like molecules split into their constituent atoms. This procedure illustrates

the unlimited array of meanings made possible by rearranging the elemental materials of language. Intriguingly, Schmaltz's selection of source words—'semblance', 'feeling', 'information', 'embodiment', and 'communication'—and the combinatory process he subjects them to suggests that meaningful communication can, and often does, happen outside the structures of semiotic signification.

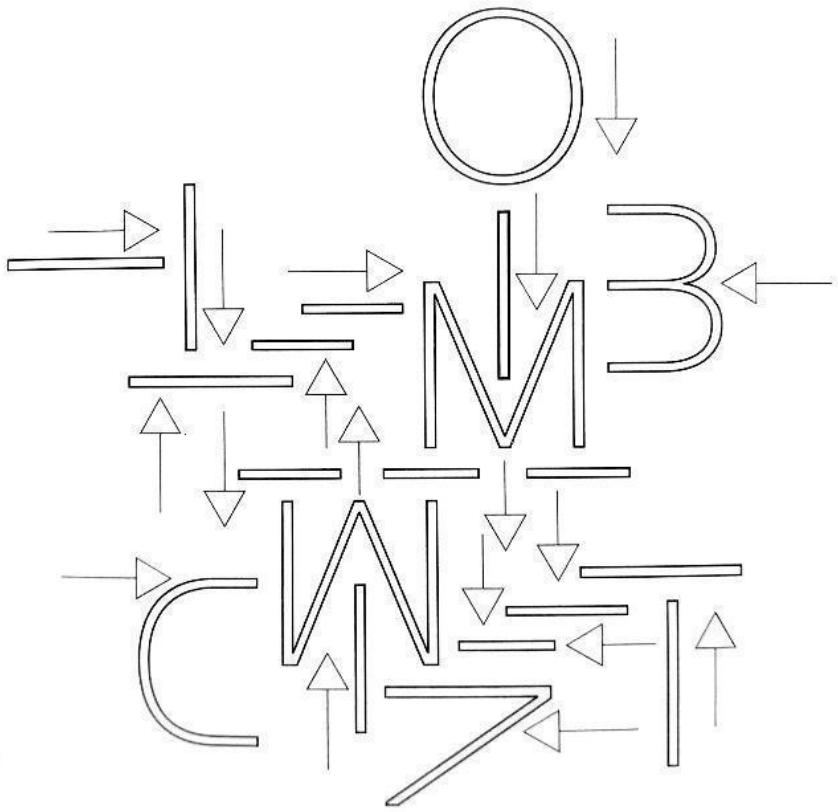

Figure 6. "Assembly Line" from *Surfaces*, scanned excerpt (Schmaltz 79).

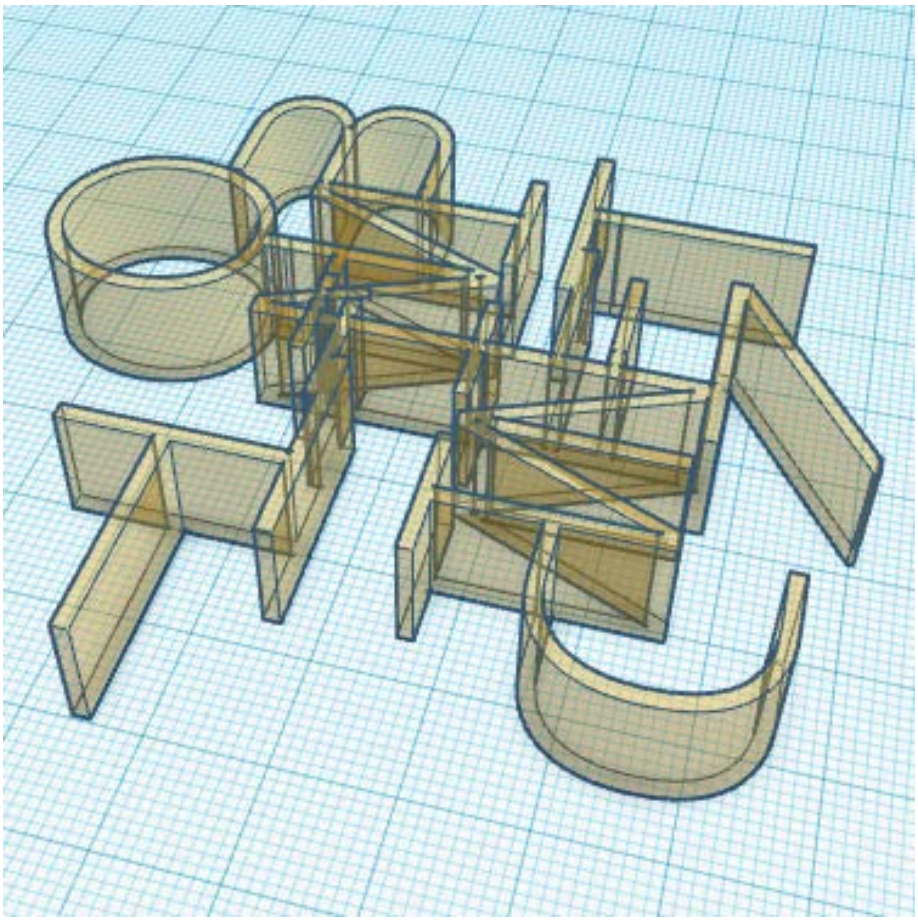

Figure 7. “embodiment” from “Eric Schmaltz : from Assembled Lines,” screenshot of 3D model (Doody and Schmaltz).

Schmaltz adapted several of his two-dimensional visual poems with the assistance of Christopher Doody into 3D models using the free browser-based modeling application Tinkercad. Their digital models constitute an important step in the translation of Schmaltz’s poems from the surface of the page into physical objects with their own materiality and presence. The vectorized wireframe models are significant as they add a third dimension, height, to the heretofore flat visual poems. The height of each of these 3D models is defined in virtual space relative to its length and width. Vector imagery can be scaled up or down arbitrarily, so while the page dimensions of

Surfaces dictate the final size of “Assembly Line” in print, virtual models of the same poems can display at any size, or from any perspective. Screenshots of Doody and Schmaltz’s wireframe models appear in the online poetry journal *h&* under the title “Eric Schmaltz : from Assembled Lines” (see figure 7). The publication features three semi-transparent, colorized models shown from different perspectives, their overlapping faces and line segments creating densities of color like layers of stained glass. As with the printed versions, the material properties of the digital medium constrain these screenshots relative to the vector models they represent, including experience-defining factors like image resolution and file type, website design and accessibility, and display size and color gamut.

While Schmaltz and Doody present the screenshots as documentation of their creative process for making 3D-printed objects, these images are especially useful for thinking about literary artifacts with transmedial incarnations. The screenshots are no less visual poetry than the original images published in *Surfaces* and therefore, in keeping with Samuels and McGann’s principle of deformance, constitute literary artifacts in their own right. Moreover, there is a high degree of tension between the screenshots as they appear to human readers—on a flat screen as 2D representations of 3D models—and how the virtual models appear to the computer processor, i.e., as mathematical formulae representing the various lines, vertices, faces, and transparencies of the vector models. The computer doesn’t ‘see’ this data in the human sense, it doesn’t visualize the model in three-dimensional space when a human user manipulates its orientation; rather, it applies changes to the mathematical formulae via a nested series of machine languages, performing calculations in code legible to its modeling application and graphics processing unit (GPU), and only translating those operations into visual output as the last step in its mediation of this information for human consumption.

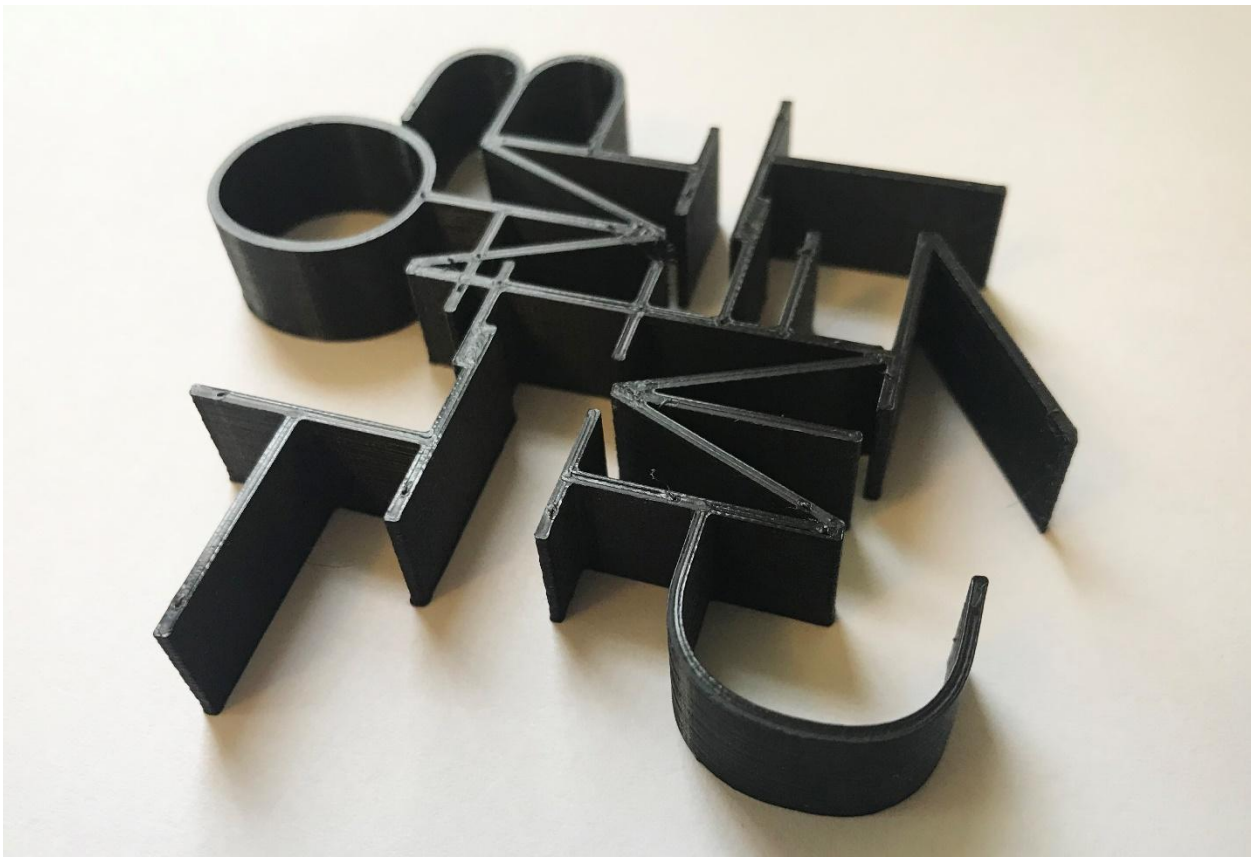

Figure 8. “embodiment” from *Assembled Lines*, 3D-printed object (Doody and Schmaltz). Photo by K. Flemmer.

Three models were eventually rendered in polylactic acid (PLA), a biodegradable plastic material,[21] for exhibition at the Philadelphia Avant-Garde Studies Consortium (PASC) Symposium at the University of Pennsylvania in December 2018 (see figure 8). Though Schmaltz frames them as sculptures, these 3D-printed objects qualify as literary artifacts in my eyes in that they are derived from visual poems. Perhaps there is hesitancy to label a three-dimensional object

[21] There are many kinds of filament available for 3D printers. PLA is very common, but it is possible to print with nylon, metal-filled, ceramic, water-soluble, and other specialized filament materials. More is said on the biodegradability of PLA in Part 2, “Writing in a Material World.”

as a poem, given that sculpture already serves as a sufficient classification for artifacts such as this. Writers, scholars, and publishers alike still routinely dismiss 2D visual poetry as insufficiently literary, and so *Assembled Lines*, removed by several degrees from the source words as they appear in *Surfaces*, may at first glance seem difficult to justify as poetry. Then again, consider that 3D printing is not all that different from the act of writing. Much like a pen, a 3D printer's extrusion nozzle passes over the flat surface of a printing platform, laying down plastic filament instead of ink. As Schmaltz's objects are essentially identical to their 2D analogs, but with the added height dimension, the printer writes the same 2D figure over and over, building up layers of PLA filament until the height of the extruded material corresponds to that of the virtual model in the computer.

There are some provocative ramifications to instantiating visual poetry with 3D printing technology. 3D-printed models are returned from the boundless conceptual realm of vector formulae by way of the physical conditions of their manufacture. Just as the page size of *Surfaces* limits the dimensions of the "Assembly Line" series, the surface area of the printing platform and the maximum height of the nozzle over the platform limit the size of the object poems. Taken together, these parameters define the maximum printing volume of the 3D printer. The fineness of the printer's motors and the gauge of its nozzle restrict the amount of detail a printer can achieve within that volume, so there are limits on miniaturization and precision as well. Material factors also influence the quality of the print. Filament is extruded while warm and flexible and can support only so much free-standing weight; too many layers on too narrow a base and the figure will deform. Finally, 3D printing is exceptionally time consuming relative to other methods of manufacture. It only makes sense to produce a few of the same virtual model before considering alternatives like plastic injection molding. For this reason, 3D printers are primarily used for prototyping and other short-run applications. Rather than real barriers, I find these constraints lend

3D-printed objects a totemic quality. The traces of their making are unavoidably visible, embedding them in the spatial, material, and technological contexts of their production.

My assessment of the totemic quality of 3D-printed objects runs directly counter to an important aspect of *Assembled Lines* as a conceptual work, namely, its invocation of the assembly line as a form of mass production. In an interview with Spinosa, Schmaltz states:

> I also think *Surfaces* is a bit funny and satirical at times. I mean, I even went as far as materializing the objects invented in "Assembly Line" with a 3D printer. The poem embraces the assembly line's logic from start to finish (someone's even offered to buy the full set, so it could have been transactional too). (Qtd. in Spinosa, "Dani Spinosa : Intersponse 1: Eric Schmaltz")

While the 2D versions of these poems absolutely do subject language to "the assembly line's logic," the use of a 3D printer to manifest them as tangible objects defies this logic to a certain extent, thanks to the abovementioned physical limitations. In my view, 3D printers are more useful for prototyping and the production of art than they are for mass production. Furthermore, it's unusual for an artist to produce more than a few identical sculptural artifacts, and while virtual models can be duplicated ad infinitum, 3D-printed objects cannot. According to Schmaltz, he and Doody produced a few larger versions of *Assembled Lines*, which took ten to twelve hours each to print, and a slew of smaller ones as promotional material for *Surfaces* ("query"). I have a smaller print of the 3D model derived from the source word 'embodiment', and despite being a product of technological innovation and consumer convenience, I find it still possesses the aura of an artifact in the Benjaminian sense.[22] The object poem signifies the concept behind the word just as directly,

[22] Walter Benjamin proposes that artworks have an 'aura' resulting from their unique presence in space and time. An artifact's aura is connected to our sense of its authenticity. Benjamin therefore argues that art loses its aura if it becomes reproducible. See Benjamin, "The Work of Art in the Age of Mechanical Reproduction."

if not more so, than the version in the book. The presence of the poem in three-dimensional space, its interaction with my senses, is so immediate that I am able to form a clear impression of the object's significance even before determining its source word. Rendering the poem as an object adds to or augments whatever messages are conveyed by its presentation on a page or a screen. By way of the 3D printer, *Assembled Lines* partakes in additional layers of meaning which speak to the importance of hardware and the intersection of technology, culture, and industry.

Invisible Interfaces

Following on the example of *Assembled Lines* and the principle of deformance, I argue that poetic meaning is cumulative. Each version adds to the overall significance of a poem through the specifics of its material composition with respect to human sensory perception. This is why media theorists like Kittler, Hayles, and Emerson stress the importance of the human/machine interface, where exchanges between human subjectivity, poetic content, and material form take place. Transmedial poems may very well involve several different interfaces working in tandem, and while Hayles' method of media-specific analysis effectively determines the influence on the poem of each in isolation, my method of composite analysis expands on her approach to include the significance that translating from one medium into another generates. The material circumstances of production mark a poem, and even the peripheral involvement of computers leaves an impression that may figure into interpretation, including those exchanges hidden from readers' view. By hidden exchanges, I mean both the effects of interfaces used earlier in a poem's lifecycle and the effects of the operations a device's GUI conceals. In this section I take up various interface theories to develop an idea of hidden exchanges and their import, particularly the drive toward interface concealment and erasure through miniaturization, integration, and ubiquity.

Human/machine interfaces are under constant pressure from innovations in other technical fields, and vice versa. Miniaturization, for instance, is a main factor in the history of interface design. As devices are made smaller and smaller, there is less surface area available for users to interact with by way of buttons, knobs, screens, and so forth. Poibeau touches briefly on the speech-to-speech and auto-captioning applications of machine translation, explaining how speech interpretation technologies are under constant developmental pressure because, as we move toward smaller devices, it becomes more difficult to type (249). Just as the advent of keyboards moved the focus of human activity from the hand to the finger,[23] it is now moving on to the voice: sound over touch, waveform over projectile, automatic recognition over manual manipulation. Voice-activated personal assistants, media services, and home automation systems are becoming more prevalent all the time, shifting human contact with devices toward the pulsing fluctuations natural to electronic circuitry and wireless data transmission. And yet, it is also a shift toward the natural medium of human communication: speech, which precedes writing. I love to write by hand, but I am ham-fisted with a pen, and smartphones may have incredible processing power, though nothing is more painful than typing on one. The promise of miniaturization is the disappearance of technology into the background, preventing human clumsiness and unwieldy interface design from coming between users and their media.

On the subject of vanishing interfaces, Kittler's "There is No Software" seems prescient today, twenty-five years after it was first published, when hardware is rapidly shrinking and the

[23] "The typewriter, which involves only fingertips, draws us away from Being," Han argues, before quoting Martin Heidegger: "[T]he typewriter veils the essence of writing and of the script. It withdraws from man the essential rank of the hand, without man's experiencing this withdrawal appropriately and recognizing that it has transformed the relation of Being to his essence" (qtd. in Han 37). Digital gestures, as in gestures made by fingers, have replaced the primacy of the hand without a chance for us to adapt cognitively, exposing the fickle human subconscious to the instantaneous gratification of digital systems like online shopping and social media. Hayles frames this problem as one of exporting cognitive functions to machines, for instance, the automatic use of a mouse or trackpad by a human hand to guide a cursor on screen.

boundaries between machine and natural languages are collapsing. Kittler argues that "perfect graphic user interfaces, since they dispense with writing itself, hide a whole machine from its users." By "whole machine," I take Kittler to mean all the material circumstances indicated by Munster, from the physical means of human interaction and the internal operations of code to the sociohistorical conditions of that machine's production and use. A decade after the Apple Macintosh debuted with an integrated CRT monitor, Kittler predicted that GUIs would create problems for users because they cleverly conceal the material contingency of digital devices. A decade later the first mobile phone came equipped with an integrated touchscreen display. Ubiquity and interoperability cause consumer electronics—wireless home networks, active listening devices, cloud computing, cross-platform portability, the Internet of Things—to fade from view as we accept hardware as given, entrenched, as it already is, in daily life. Moreover, Kittler accuses the technology industry of an ulterior motive in moving hardware into the background: "Precisely because software does not exist as a machine-independent faculty, software as a commercial or American medium insists all the more." The more consumers are alienated from the material contingency of their digital devices, the more readily they will accept information, mere 1s and 0s, as a form of property. Tech companies are then able to sell not only devices, but individual applications, software licenses, downloadable game content, user data, and so on.

I find myself seduced by Kittler's arguments, especially given my interest in the materiality of language in a digital context. There is truth in the idea that all computing boils down to material phenomena, that without hardware there would be no digital poetics. The creation, storage, dissemination, access, and interpretation of digital poetry is impossible without physical systems and infrastructure. On the other hand, insisting on this point seems a little pedantic. Yes, GUIs

built atop a hierarchy of machine languages tend to obscure the physicality of the machines, but reducing the sense of material labor through intermediary mechanical processes is precisely why one uses a computer, or any tool for that matter. To what degree is it necessary to expose the various levels of processing going on when readers interact with a computer? Is it not antithetical to the efficiencies that computer processing enables to make every operation explicit? Even most computer scientists avoid working directly with lower-level languages, instead relying on integrated development environments (IDEs) and program libraries to write in higher-level languages intelligible to human beings. The question, then, is not whether digital poetry can or should be reduced to the operations of hardware, but how hardware contributes to digital poetry via the material qualities of its interface.

Emerson adds considerable nuance to Kittler's position. In *Reading Writing Interfaces*, she also critiques the movement of human-computer interfaces toward ubiquity and therefore invisibility, though Emerson insists that 'invisibility' actually means a hegemony of one kind of interface, a monoculture suppressing choice and anything more than a superficial understanding of the device's inner workings. The real reason why interfaces are less noticeable, according to Emerson, is the tech sector's shift from open design philosophies toward an ideology of user-friendliness, or toward interface designs requiring little to no special knowledge for users to interact with them. Emerson writes: "[T]he extent to which the interface is designed to mask its underlying machine-based processes for the sake of the user is the extent to which these same users are disempowered, as they are unable to understand—let alone actively create—using the computer" (47). User-friendliness entails sameness in design and restricted access to the backend of software, but an interface that hides a whole machine behind it alienates users from many of the possible applications of computer processing by dictating how the device is to be used, and for

what. Prescriptive interface design restricts users' "access to knowledge and their ability to produce knowledge," Emerson argues, because it converts agential human subjects into "devoted consumer[s] of ready-made software and ready-made information to which whose framing and underlying (filtering) mechanisms [they are] not privy" (49).

In Emerson's opinion, Apple is largely to blame for the trend toward interface invisibility, both in their push for the hegemony of a single interface, and through their proprietary software. I agree, though the second charge—that of promoting closed-source, black box software, i.e., software which conceals its inner operations—describes the behavior of much of the for-profit tech sector. Consider the iOS mobile operating system Apple implements on the iPhone: both the interface it presents via the touchscreen and its closed backend limit the choices available to iPhone users. The iOS interface is rigid and childish, presenting colorful buttons with soft, rounded corners in a grid that can be rearranged, though the method of interacting with the application icons and the pattern of their arrangement are fixed. Consider also that Apple vets all third-party apps developed for iOS, making them available for download and install only through their official app store, a process which discourages freeware, DIY and community-driven app development, ad hoc or improvisational usage, hacktivism, and other enticements to unsanctioned creativity. Emerson quotes from the *Apple Human Interface Guidelines* from 1988, which state: "[p]eople aren't trying to *use computers*—they're trying to get their jobs done," to which she responds, "use, not the accomplishment of tasks, is what makes creativity and learning on a computer possible" (83, emphasis Emerson's). Despite having over one billion active users,[24] each with their own particular needs, tastes, lifestyle, and workflow, Apple places barriers between users and the full

[24] "Apple CEO Tim Cook told Reuters in an interview that […] Apple now has an installed base of more than 1 billion iPhones, an increase over the 900 million the company most recently disclosed in 2019" (Nellis).

functionality of the iPhone as a creative instrument by presuming it can determine which jobs need doing and what constitutes the superfluous use of their products.

Apple is not the only tech giant with a notoriously closed design philosophy. Black box software and proprietary, closed-source applications are increasingly the norm in a profit-driven industry, each concealing machines from their users in separate but related ways. Black box software accepts input and produces output without revealing its operations or decision-making processes, while the source code of closed-source software is not freely available. These applications are oftentimes distributed as pre-compiled, executable sets of program files which users cannot alter. If, as Marino argues with respect to binary, meaning does not end with the conversion of symbols into electrical impulses, and "layers of signification […] proliferate on the level of hardware, code, and running software," then readers in black box or closed-source software environments are prohibited from accessing some of those layers of meaning (196). To my mind, this bolsters Marino's call to look at all aspects of a program as potential sites of interpretation and meaning, especially those which are hidden. Marino urges media and literary scholars to "no longer speak of the code as a text in metaphorical terms, but [to] begin to analyze and explicate code as a text, a sign system with its own rhetoric, as semiotic communication that possesses significance in excess of its functional utility" (39). Schaefer, too, issues a call to look at everything—code, metadata, glitch—as potentially meaningful when analyzing transmedial literature, insisting that "all versions of a literary text—and the different modes of composing, disseminating and engaging with the text that these entail—are part of literary culture" (178). I propose that, when confronting the erasure of digital interfaces, literary critics ask—in addition to: what am I missing?—what am I kept ignorant of? How is the tech industry's shift toward concealment at odds with my goals as a reader and critic?

Digital poets and artists have long pushed back against the disappearance of the interface, using hacktivism, glitch, and machine-use subversion to expose users' assumptions about digital technologies, as Naji, Ramocki, and others point out. Emerson also touches on the poetics of glitch, arguing that disruption "defamiliarizes the slick surface of the hardware/software of the computer and so ideally transforms us into critically minded observers of the underlying workings of the computer" (36). Glitch returns readers' attention to the device in hand, to the material incarnation of the text. Emerson therefore incorporates case studies which "[draw] attention to the limits and possibilities of a particular reading/writing interface," or that make the invisible visible (166). Hacking and glitch work to rematerialize the interface by butting up against its limitations, making failure and breakdown generative. Such practices recall beaulieu's notion of libidinal excess, transforming machine excess and waste into poetry. With the aforementioned positions in mind, I argue that interfaces—where humans and computers interact and digital materiality comes to be—are the site of an ideological struggle between user freedom and a narrow hegemony of machine-use design.[25]

As mentioned above, a digital poem's materiality is constructed, at earliest, during the reading process. Poets cannot know the material specificity of their poems until they produce them; rather, transmedial poetry is a form of exploration, testing the limits of media and materials by crashing into them. In spite of the ubiquity of a certain kind of interface, it is as yet impossible for critics to circumscribe a domain including every possible material instantiation of digital poetry. Material components structure and inform readers' access to the content of digital work, leading to a paradigmatic shift in our readings of literary artifacts, and "offer[ing] new avenues through which meaning can be formed and expressed—a new apparatus of influence" (O'Sullivan 101).

[25] I unpack the sociohistorical circumstances of this struggle further in Part 3.

However, this new apparatus of influence is embedded in the ideological interests of technocapitalism, and so readers must be cautious, lest we forget how the interface structures our assumptions and analyses. As O'Sullivan reminds us, "[n]ot all people are equally digital" (7). Not all meaning is equally accessible, a consequence both of the material contingency of digital technologies, situated as they are in sociohistorical circumstances, and the deliberate alienation of computer users from hardware and source code. The preceding survey of digital materiality and interface theory shows that, without attention to this aspect of a digital poem, any number of meaningful facets might remain hidden from a reader's view.

A Summing of Parts

In the previous section, I claimed that poetic meaning is cumulative, that each version of a transmedial poem adds to its overall message. If meaning really is cumulative, what is the result of contradictory interpretations encouraged by different versions of the same poem? I ran into this challenge when evaluating Schmaltz's *Assembled Lines*. On the page, the poems extend the logic of mass production, while, in my reading, the 3D-printed versions refute it. Instead of attempting to reconcile this contradiction, I assert that difference and gap are meaningful. Both the extension and refutation of assembly line logic can exist in a poem concurrently, and the difference between these opposing positions is also significant. Recall the oppositional slash in the titles of *O/Ô* and *Un/Inhabited*, which signal the binary oppositions these poems simultaneously preserve and collapse. Digital poetry can exist in multiple states, both either-or and both-at-once, and so the transmedial space between instances is meaningful. The gaps between materials are a kind of material that can be written with and read in their own right, akin to zero in binary code as Burckhardt and Höfer figure it: the space occupied by a potential something. Difference is

potential, and the tensions formed between divergent versions of a poem are forms of storytelling that contribute to its overall significance.

To illustrate this point, I return to the 3D-printed poem with which I opened this study. *Loss Sets* is a series of 3D-printed visual poems derived from texts co-written by Tucker and Scott responding to various kinds of loss suffered personally, culturally, environmentally, and artistically within the wider context of their creation in 2016, from the accelerated melting of Canadian ice fields and the destruction of ancient cultural artifacts by ISIS to muscular degeneration, memory loss, and the death of loved ones. However, the object poems and the texts used as input for their generation speak to this sense of loss in strikingly different ways. The lyric poem "Loss Set 2: Spiral Expansion of Muscles in Movement" (see figure 9) mentions the poet's grandfather, "recently dead […] his memory fell apart, poked with diseased holes" (Scott and Tucker 30–32). The corresponding object poem is shot through with tangible holes in its physical form. Tucker's translative workflow went through several iterations as the project was developed, but the final objects are rendered as cubes with irregular geometric faces carved out, resembling blocks of Swiss cheese or the Borg cube, which is really the closest visual comparison I can conjure. Tucker and his collaborators frame the 3D-printed objects as sculptural poems, in the sense that a computer, in modeling the text, subjects a perfect cubic form to a process of subtractive deformation not unlike the carving out of material from a block of stone.

The translative process of *Loss Sets*, devised by Tucker, Tiffany Cheung, and Namir Ahmed, begins by converting the text of each poem into Cartesian coordinates along X, Y, and Z axes. First, it splits the poem into three-character groups. For instance, the first few words of "Loss Set 2," "imagine a hand," are broken up into: 'ima', 'gin', 'eah', and 'and'. A simple substitution code then replaces each of the twenty-six letters of the alphabet, plus six different punctuation

marks, with the numbers 1 to 32: ‘a’ equaling 1, ‘b’ equaling 2, and so on. The resulting three-integer groups map onto coordinates, each corresponding to a point on a 32-unit grid in 3D space. The ordered triple (9, 13, 1) represents ‘ima’, the first point resulting from “Loss Set 2.” The authors supplement the coordinates furnished by the poetic text with coordinates generated from data collected at the Columbia Icefield, then import the lot into the 3D modeling software Rhino. Rhino converts the coordinates into vertices which the software plugin Grasshopper automatically connects to create faces that can be subtracted from the 32-unit cube (see figure 10). The resultant virtual models are then printed with a 3D printer.

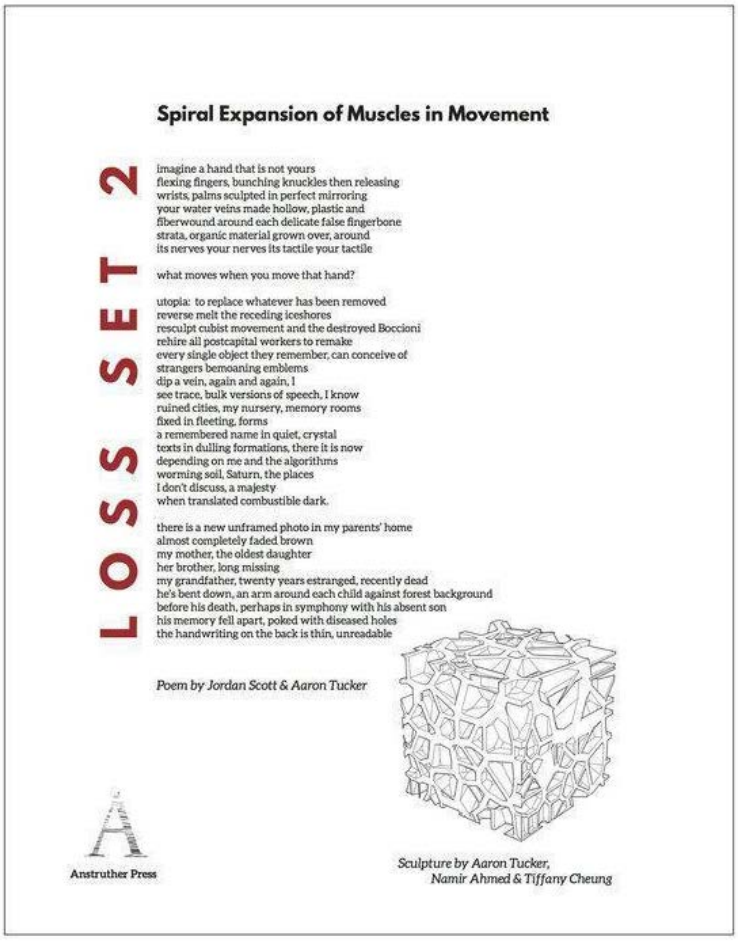

Figure 9. “Loss Set 2: Spiral Expansion of Muscles in Movement” from *Loss Sets*, broadside (Scott and Tucker).

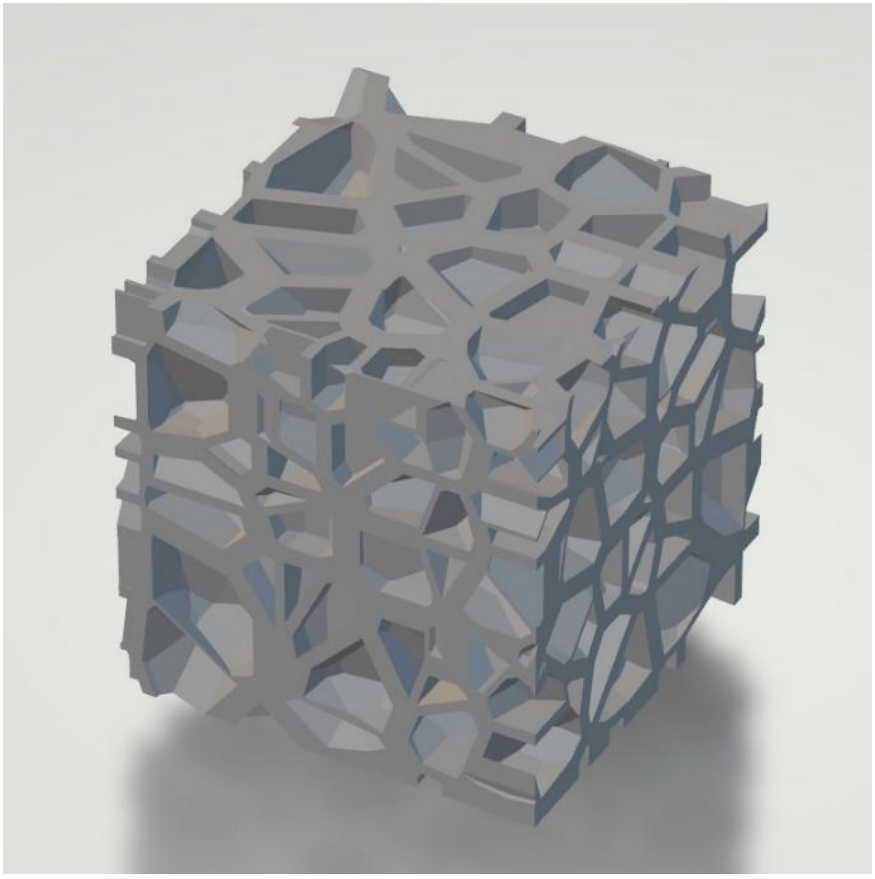

Figure 10. “Loss Set 2” from *Loss Sets*, 3D model (Tucker et al.).

In the earliest version of the workflow outlined above, Tucker manually input Cartesian coordinates into the 3D modeling software, then connected them to form an irregular solid. I think of this process as molding, or shaping something from raw material, rather than sculpting, which begins with a set object and subtracts. *Loss Sets* is actually only sculptural in the way Tucker uses the term when it resides in the computer as a digital model. Once instantiated with a 3D printer, which extrudes material and is therefore additive, the object poems are no longer sculptural in the truest sense. *Loss Sets* combines a subtractive process with an additive one. Even if we argue that the poem’s original meaning is lost in translation, it is nevertheless true that meaning is also added. 3D printing as a manufacturing process opens these object poems to contradictory modes of

reading and interpretation. In my view, the tension resulting from the coexistence of contradictory modes is an integral part of the poem, contributing to its significance.

Later versions of Tucker's translative workflow involve computer generation in that the Rhino software with Grasshopper plugin generates the 3D model from the given coordinate points without further human input. This aspect of the project, as Tucker points out in his own critical commentary on the work, introduces an element of machine co-authorship. Where previous versions used the processing power of the computer to execute Tucker's instructions, in the latest workflow the computer is responsible for making decisions about the model's final shape, specifically how the coordinates are to be connected as vertices and how various faces will be subtracted from the cubic form. Add to this the astounding number of operations in various machine languages needed to render the thirty-three lines of text of "Loss Set 2: Spiral Expansion of Muscles in Movement" into physical space, from the text-to-ordered triple conversion to the instructions the computer passes to the 3D printer. Consider also the sheer number of computations necessary to manipulate an interactive 3D model in virtual space; when a viewer rotates the model, for example, the computer must reposition each of the model's vertices in three-dimensional space before the figure can be redrawn on screen.[26] As I have mentioned, computers are effective at hiding their own labor, processing information faster than human users can track. Most users only ever think about processing power when confronted with its limits, with lag or clipping when demand exceeds supply. If all goes well, the interface conceals the code's execution, distancing digital poets from the products of their creative labor while diminishing, in the eyes of their readers, the Benjaminian aura of the poetic artifact. In my reading, *Loss Sets* also tells the story of this

[26] "Loss Set 3" is published to the 3D model database *Sketchfab*, where users can view, interact with, and download it. Tucker sent an STL file of "Loss Set 2" directly to me so that I might print a copy.

forfeiture, the loss of artistic practices grounded in the physical possibilities and limitations of the human body.

Humans have used tools to produce writing for as long as we have written, and I am not decrying their use so much as advocating for awareness and transparency when using tools that sever or obscure the connection between bodies, artifacts, and audiences. In all fairness, 3D-printed art objects resist their separation from creative labor to some degree, as in the 3D-printed versions of *Assembled Lines* resisting the logic of mass production. 3D printers are normally for prototyping, and, given their relatively slow operation, it does not yet make sense to use them to manufacture items for mass market distribution. There is also a charming crudeness to 3D-printed objects; you can almost follow the path of the filament with your finger, tracing the motions of the extrusion head. I get a real sense of materiality and the method of production from the texture of the *Assembled Lines* and *Loss Sets* poem objects. *Loss Sets* in particular exhibits tensions between the various kinds of loss it symbolizes and the accretion of its material form, between the subtractive nature of sculpting and the additive process of printing. These tensions are another kind of story made manifest by *Loss Sets*, one about the destruction of the present, the construction of a past, and how stories themselves are attempts to capture and express fleeting human experiences.

Loss Sets prompts many questions about authorship and legibility in the digital space. For whom are these poetry objects most legible, the human observer or the computer processor? Can a 3D-printed object be considered an information storage apparatus akin to books or disk drives? People might find it difficult, or indeed impossible, to divine the source poem from the various facets of the 3D-printed object. Could a computer undertake this interpretive act? Perhaps the vector models, with their precise and codified formulae, are more meaningful to a computer than the object poems. Perhaps the same is true of the original text poems with regard to human readers.

Objects, then, are not the most legible form in which to store these poems, so far as access to their textual content is concerned. If not storage, what does the translative procedure have to offer the *Loss Sets* project?

There is an obvious lack of fidelity to the semantic sense of the source text in Tucker's translation of written poems into 3D-printed objects. However, I feel the object poems manage to retain the central concerns of their textual equivalents. The pits and valleys in the surface of the plastic cube evoke crumbling icefields and wasted flesh, and the palpable sense of decay and loss in the text of the poem is represented viscerally and directly, object to body. Appealing to the sense of touch as well as sight does not make these objects any less literary, just as derivative work may carry additional meaning without diminishing the original. Not only is the source text embedded in the object poem, new stories are embedded along the way. "3D objects are tactile and material," writes Tucker in "Beyond 'Whiz-Bang'": "Once printed, they can be picked up, turned over, and explored from a multitude of angles; the objects have concrete weight and volume that point to a set of aesthetic values that straddle the digital and analog" (9). The object poems of *Loss Sets* do more than represent their originals or vector models, they carry an abundance of symbolic meaning in their own right. They are each, as Tucker calls them, a "tactile metaphoric argument" contributing to the overall meaning of the project ("Beyond 'Whiz-Bang'" 1).

Tucker argues that 3D objects have an advantage over printed or displayed texts in that they have physicality which can be appreciated by multiple senses. While books, too, have weight, smell, taste, and make sound, I think Tucker is gesturing to the fact that books and screens bear the message while 3D objects are the message. This position reminds me of the emphasis Hayles places on the mind/body interface and on proprioceptive interactions with a text. In Tucker's opinion, "the object becomes the central, sensual, material object networked with its surrounding

environments" ("Beyond 'Whiz-Bang'" 4). These objects become primary in our understanding of the transmedial poem via their physical and sensual presence. I don't necessarily agree with the centrality of the object in transmedial literary projects; I've come to habitually distrust models of the center versus the periphery. Rather, I imagine an object networked with its multiple environments and the "broader social constructions and virtual technologies" which constitute the digital materiality of a computer-mediated poem (Tucker, "Beyond 'Whiz-Bang'" 4).

Tucker proposes that an object's "'narrative' or larger systems of meaning are first and immediately present in the sensual interactions with the objects" ("Beyond 'Whiz-Bang'"4). The meaning of an object should be available to the senses, without prior recourse to a critical exegesis or source text to explain the object. I find this directness in Tucker's own creative work, both in the chaotic imagery of *O/Ô* and in the physical presence of *Loss Sets*. The subjects of his 3D-printed poems are immediately legible in the gouges seemingly carved from the surface of the cubic form: loss, physical absence, deformity, and the representation of such. Poetry offers meaning and narrative, according to Tucker, first and foremost through sensory perception and bodily interaction. He makes a strong case for the primacy of materials, though I reiterate that much of the power of transmedial poetry lies in what is lost and gained between versions.

I think of *Loss Sets* as a transmedial poem, though it's true that Tucker's creative process follows more of an interdisciplinary than a transdisciplinary workflow, in the sense that Tucker involves collaborators who can assist in areas outside his expertise. Scott co-authored the written poems, while Cheung and Ahmed helped Tucker develop modeling and printing processes which also consign a degree of authorial agency to the computer. As transmedial workflows become increasingly accessible to digital poets—i.e., as computer applications become more powerful, modular, and intuitive to use—it seems to me that there is a trend in creative practices toward one

person being capable of more things. Even so, the appearance of solo authorship in the digital milieu is only accomplished with the help of those we may not normally consider co-authors. Consider the unnamed *YouTube* programmers behind the auto-captioning function that generates the content of Robinson's *The Sims in Real Life*; both they and the program they created are co-authors of the text to some extent, though the programmers go unnamed in the credits. Rather than solo authorship, I conceive of this network of collaboration as a form of distributed authorship wherein many agents, human and otherwise, make differential contributions to the creation of a text through a range of media, perhaps without even knowing it. In arguing that a digital poem is co-authored by an agential network, though perhaps directed or focalized by a single author, my aim is to enhance literary criticism with a posthumanist look beyond the individual, grounding the analysis of transmedial digital poetry in the material circumstances of its production.

There are some real-world barriers to developing a transdisciplinary critical practice in response to digital poetry, not least of which is institutional resistance to interdisciplinary studies, a subject I address in Part 3. For now, I must express my gratitude for the assistance and generosity I received from the staff at the University of Calgary's library when I went to print an object poem from *Loss Sets*. Ever since getting to hold one of Tucker's poems at the conference in Victoria, I have wanted one of my own. And so, when Tucker offered to send me the model file of "Loss Set 2," I jumped at the chance to produce a copy on the 3D printers at the Taylor Family Digital Library (TFDL). I had never used a 3D printer before and was eager to get a little hands-on experience. Unfortunately, an unexpected obstacle presented itself in the form of a global pandemic, making many of the university's resources inaccessible. Nevertheless, I was able to coordinate with Jeremiah Baker, Emerging Technology Specialist at the TFDL, on two test prints of "Loss Set 2." At the time, the LabNEXT Makerspace where the university's 3D printing resources are kept was

closed. Even the general orientation and 3D printing tutorials normally offered by the library were on hold, and so my plan to get some practical experience with this technology was foiled. Luckily, Baker offered to undertake the prints on my behalf; he had recently done some routine maintenance on the university's machines and needed to perform follow-up tests to evaluate his work. We discussed the fussiness of the printers and how they require regular cleaning and maintenance to function at their best, which is, as Jentery Sayers points out, no better than a "glue gun tethered to a computer" (2).

Baker made two test prints of "Loss Sets 2" at a consistent size, but he printed the second model with an extrusion head three times smaller than the first, and thus it has three times the detail and took three times longer to print. Oddly, the print with less detail came out looking cleaner. Baker tells me that unexpected outcomes are common when using 3D printers. Sayers makes a good point about imperfect technologies:

> Through a paradigm of variability, we may look for stress points along a continuum of material change, or points where remaking, remediating, repurposing, modifying, altering, layering, repairing, warping, morphing, transforming, versioning, or bending occur. Taken together, these stress points highlight the negotiated endurance of material culture: how, to be clear, the lifecycles of materials are negotiated over time, not somehow determined or prebaked into machines. (7)

My suspicion is that trial and error is common in transmedial endeavors, and error is difficult to suppress entirely. However, inconsistency from a materials standpoint is subjective, and from the perspective of the vectorized 3D model, any physical instantiation will be imperfect. "With digital fabrication, turning this into that is indeed a process of iterative change and constant negotiation, which is never reducible to code in the last instance" (Sayers 7). The inability of digital

technologies to perfectly remediate physical artifacts via code dispels any lingering notions theorists might harbor that code is actually the common substrate of the world, as feared by the heralds of digital apocalypse, Han, Burckhart, and Höfer. Tempting as it is to reduce digital poems to their coded essence or the fact of their executability, exposure to fabrication technology foregrounds the exchanges and compromises perpetually taking place between physical media, symbol systems, and human readers.

Writing in a Material World

So far throughout Part 2 I have focused on digital materiality as it relates to hardware, the interface, and the physical operations of machine languages, though Munster indicates a second important understanding of materiality: the social, political, and material contexts wherein people make and enjoy digital media. Reading digital poetry with these parameters in mind requires moving beyond the materials of poetry into the wider world where they acquire meaning. Just like words, materials have variable social connotations that depend on the context in which poets deploy them. Given the entrenchment of all material artifacts in their sociohistorical circumstances, I agree with the oft-repeated idea that all art is political. However, only some artworks are explicitly political, and fewer still consciously explore the political dynamics immanent in their materials. I make this distinction in light of the debt Cecchetto argues that artists assume when using digital technologies as means of expression. Digital poetry is inherently political, and it is therefore incumbent on literary critics to ask: how does digital poetry respond to the problematic aspects of the technologies with which it is entangled?

Take the relationship between the content of “Loss Set 2: Spiral Expansion of Muscles in Movement” and the materials of its object poem. Ecological and sociopolitical statements are

among the several aims of *Loss Sets* I feel the project satisfies. The wasted geometry of the object poem adds to the significance of the source text—which speaks of climate change and the destruction of cultural artifacts—even as their translation into physical form strips away semantic sense. As climate change progresses, as precious artifacts are destroyed, Tucker's plastic figures stand in for and replace the "receding ice shores" and "destroyed Boccioni" as geological and cultural records, like unnatural fossils (Scott and Tucker, 10–11). The irony of this statement is gained, rather than lost, in its translation into plastic. *Loss Sets*, then, does not take for granted the political dimensions of its materials, instead making them overt aspects of its message.

To be clear, I do not aim to devalue poetry that is uninterested in the political or material conditions of its expression, only arguing for the additive effect of taking these aspects into consideration when analyzing digital poetry. I am certainly not alone in emphasizing the material basis of the virtual, or in pushing literary discourse toward worldly affairs. Following Hayles and other digital media theorists, Spinosa writes:

> It is easy to see the virtual as immaterial, as cloud-based, but of course it never is; all screens are pixels, all hardware a complex interplay of metals and polymers, and so on. Nevertheless, there are economic and political forces at work behind the disassociation of the digital program from the hardware designed to run such a program, forces which tend to obscure this materiality. (*Anarchists in the Academy* 172)

Spinosa refers back to Kittler to support the claim that there are business reasons for the effacement of materiality in digital spaces. Concealment, Kittler argues, holds profound consequences for the cultural products we conceive of as "written texts" in that they "do not exist anymore in perceivable time and space but in a computer memory's transistor cells." Despite this severance, Kittler asks that readers not take code compilers, BIOS chips, and "a million sleeping transistors" for granted.

I agree, though I feel the discourse can be taken further, beyond the immediate concerns of hardware and the digital media economy. Discourse about the material contingency of digital poetry needs to include systemic issues—access, education, extraction, energy consumption, globalization, and labor practices, to name an interrelated few—because these and other real-world conditions place limitations on the radical interactive freedoms Spinosa and others expect for readers of digital poetry.

Let's turn to an object poem I feel makes exemplary use of the politically-charged status of its materials. "artificial honeycomb" by Papachristodoulou is an object poem made from PLA and bio-resin with text incorporated directly into its structure (see figure 11). The 3D-printed object is a sphere of tessellated hexagonal cells, each one tapering in to the center of the sphere. About half of these cells are filled with clear bio-resin with a word suspended in it, alternating between the words 'bio' and 'techno'. In cells with the word 'bio', the text is suspended deep in its cell, near the center of the sphere, but in the 'techno' cells the word is much closer to the surface. According to Papachristodoulou, this form "points to a growing tension between biology and technology" and "denote[s] an unpredictable matrix of data that is exponentially growing and inevitably interlinked" (70–1). She includes a photograph of "artificial honeycomb" in her afterword to *Astropolis* framing the object poem as a Neo-Futurist response to colony collapse disorder and its related environmental issues. Given this framing, "artificial honeycomb" proposes an optimistically hybrid solution to widespread ecological disaster, one wherein the techno-industrial complex, represented by the 3D printing process, becomes integral to a habitable future.

Figure 11. “artificial honeycomb” from *Astropolis*, 3D-printed object (Papachristodolou 70).

Papachristodoulou characterizes her object poem as a work of Neo-Futurist art because it foregrounds “the use of cutting-edge materials and new perspectives of a technological and urban world” (69). Neo-Futurism is “neither utopian nor fully dystopian,” envisioning a “complex future […] where the human subject places itself in tension with technological progress, seeking liberation between the cracks of the monolith of capitalism” (Phillips, qtd. in Papachristodoulou 69). From a Neo-Futurist perspective, technology is value-neutral, and therefore capable of producing practical, future-facing solutions, even though the technocapitalist monolith threatens to make the world uninhabitable. It’s not an overly optimistic worldview, but the future is imagined

as not entirely without hope. And yet, it seems to me that our present—characterized by escalating climate crises and ecological destruction—is rather more dire than implied by the "growing tension" between biology and technology Papachristodoulou mentions. As such, I respond to the Neo-Futurist framing of "artificial honeycomb" by asking: to what degree does this object constitute an injunction against the monolith which produced all the materials and tools used in its making? Does the poem pay the debt the poet acquires when she takes digital technologies into her creative process? What use is a PLA honeycomb in a world inhospitable to bees?

Papachristodoulou mentions that PLA, or polylactic acid, is a vegetable-based compound, suggesting it is an eco-friendly alternative to petroleum-based plastics. I wasn't entirely sure what that entailed until I looked it up, and though it's touted as biodegradable, it turns out PLA breaks down under landfill conditions only over the course of several hundred years. The material can be composted in industrial composting facilities, but these are rare, and so, instead of biodegradation, the best option for dealing with PLA at the end of its lifecycle is to recycle it, either chemically or mechanically, just like other kinds of plastic. According to Filabot, a company that builds machines which extrude PLA filament for use in 3D printers: "plastic, once it has been industrially produced, is categorically best staying plastic. Giving this plastic renewed purpose is the key, and is ultimately a far more productive future than an impractically slow death in the ground" ("The Misleading Biodegradability of PLA"). PLA is therefore only biodegradable in the narrower sense of its industrial compostability, and so I don't regard it as particularly environmentally friendly.

Consider also that PLA is made from organic materials which must be grown, and these resources might be needed elsewhere. As Jan-Peter Willie, the co-founder of Dutch filament manufacturer 3D4Makers, explains:

> There is much debate about the total carbon, fossil fuel and water usage in manufacturing bioplastics from natural materials and whether they are a negative impact to human food supply. To make 1 kg of PLA, the most common commercially available compostable plastic, 2.65 kg of corn is required. Since 270 million tonnes of plastic are made every year, replacing conventional plastic with corn-derived PLA would remove 715.5 million tonnes from the world's food supply, at a time when global warming is reducing tropical farm productivity. (Qtd. in Valdivieso)

PLA is thus not a viable long-term solution to the pressures that technocapitalist societies exert on the environment through their dependence on plastics, industrial farming, and fossil fuels, each leading to escalating and interrelated crises like colony collapse disorder. I point this out not to indict Papachristodoulou as a hypocrite for using PLA in an eco-poem, only that I have an alternate reading of her poem, and a different opinion about how to effectively frame its message (one with the advantage of having incorporated Papachristodoulou's thoughtful afterword).

That PLA isn't particularly eco-friendly without an elaborate industrial composting apparatus isn't really a failing from the Neo-Futurist perspective, which is free to imagine a future where that apparatus is readily available. Rather than an eco-friendly object poem invoking a better future—organic materials in an organic shape with an environmental purpose, all facilitated by techno-culture—in "artificial honeycomb" I see the mongrel hybridization of biology and technology, an imperfect, stopgap solution for an imperfect, cyborg world. It reminds me of Haraway's concept of 'symbiogenesis', or the co-creation of our multispecies ways of being, ways "inevitably interlinked," as Papachristodoulou would say (71), living with and for each other even in the midst of spiraling ecological devastation at the hands of exploitative technocapitalist industries. The material design of "artificial honeycomb" incorporates both technology and

biology in a fascinating, co-constitutive fashion. However, I must insist that a PLA honeycomb can be framed as eco-friendly only in a world where we've committed to doing everything we can for bees, which is, sadly, not the world we live in. Even if the object poem were readily biodegradable, the use of ecofriendly, sustainable materials is only a small part of a fulsome approach to environmental activism through creative practice.

The criticism I have just offered is not at all a result of some failing on behalf of "artificial honeycomb" as a poem; on the contrary, I am quite fond of this project and think it successfully spotlights colony collapse disorder. Instead, I argue that Neo-Futurism as a philosophical position fails to reconcile itself with the possibility of an irredeemable present, and therefore does not adequately frame the contradictory aspects of Papachristodoulou's chosen materials and subject matter. While *Loss Sets* gains a level of irony in its translation into PLA, "artificial honeycomb" is stripped of irony by the presentation of PLA as vegetable-based, and therefore somehow eco-friendly, which I take as a Neo-Futurist impulse to sidestep a clear and present danger without much alarmism. Alarmism is disturbing, but so is living in a world on fire without alarmist responses. Rather, Neo-Futurism offers a form of escapism that "visualises eco-sensibility and technology at the core of current reality" (Papachristodoulou 71). It presents provocative and productive alternatives, but I'm not convinced that Neo-Futurism offers much of a roadmap for moving eco-sensibility into the core of this reality, which has already wedded technology to the capitalist monolith. Perhaps the true tension in "artificial honeycomb" is between fantasy and reality, between the world that could be and the world that is. In positioning her object poem as a Neo-Futurist work, Papachristodoulou makes a statement about the world that could be; my impression is that "artificial honeycomb" makes a truer, and somewhat more ominous, statement about the world that is.

I hope the preceding analysis demonstrates that literary texts are embedded in materials which are in turn embedded in a wider sociohistorical context. These aspects all come together in the hands and minds of readers to constitute the materiality of a poem. Transmedial poems may have material and conceptual properties not conventionally considered literary—like source code, metadata, or non-human co-authors—that nonetheless contribute to meaning-making and interpretation. Moreover, materiality itself is only one way digital poets might engage sociopolitical issues as a form of activism. In general, the digital poems covered in Part 2 own their status as transmedial, exploiting or even relying upon interstitial tensions to convey meaning. Importantly, Emerson reminds scholars that contemporary readers and writers have already moved beyond the preoccupations of twentieth-century experimental literature like concrete poetry and Conceptualism to "attend to the materiality of twenty-first-century digital-language production" (170). I therefore argue that, in response to digital poetry, literary critics adopt a composite or cyborg reading practice by combining methodologies and interpretive strategies from multiple disciplines to account for the meaningful characteristics of a poem which may transgress disciplinary boundaries.

Although Emerson works in media archeology and contextualizes present-day creative practices by referring to pre-digital technologies, *Reading Writing Interfaces* provides a transdisciplinary model for analyzing the political and social contexts of contemporary digital poetry. Emerson draws on media theory and archeology, literary criticism, history, and other disciplines to portray her literary case studies as situated in their many-faceted material, and therefore sociopolitical, circumstances. Marino's *Critical Code Studies* also works across disciplines to build a coalition of interpretive strategies, treating source code as "located in a broader communication exchange" through which it acquires extra-functional significance (8).

Marino stresses the importance of devising new reading practices and analytical frameworks informed by a multitude of disciplines and encourages academic institutions to adopt critical code studies as an acceptable, and perhaps even necessary, form of transdisciplinary research. Taken altogether, critics who attend to the composite materiality of digital poetry—like Marino and Emerson, Hayles and Spinosa—make a strong case for the need to cultivate critical transliteracy, or the ability to read and interpret many forms of media. Cyborg readers need not limit themselves to enumerating and analyzing the facets of a digital poem from discrete disciplinary silos. Rather, cyborg reading accounts for their interrelationships. The ability to read for connections between media is especially important in a cybernetic milieu, where everything is related to everything else by way of a global network of information technologies. In the next chapter, I focus on the development of transliteracy as an essential competency for cyborg reading practices.

Part 3 – Cyborg Milieus

I learned at the outset of my graduate studies that there is a little bit of wiggle room in the degree requirements, that with special permission I could take an undergraduate-level class or something in another department, so long as I could justify it as relevant to my research. I took a look through the course calendar and knew as soon as I saw Creative Computing—which the Department of Computer Science offers as part of the interdisciplinary Computational Media Design (CMD) program—that this was the course for me. Only problem: Creative Computing is scheduled irregularly, and I was looking at a previous year's course offerings. I reached out to the CMD Program Director and found that, if I could drum up a certain amount of interest in the class, it would be possible to hire a sessional instructor to teach it. And so began a lengthy campaign to recruit interested graduate students, each of whom would have to justify a need for the course to their various departments. I emailed almost every graduate student enrolled in humanities programs at the U of C to find the minimum number of students required to schedule the Creative Computing class, and most of my fellow registrants ended up coming along from the Department of English, including my friend and frequent collaborator, Marc Herman Lynch.

Lynch and I have long worked together on *filling Station* magazine, a Calgary-based experimental literary journal, so when it came time to start the major research-creation assignment for Creative Computing we teamed up again to produce an interactive visual poetry program written in the Processing programming language and IDE. The Social Sciences and Humanities Research Council, who partly funded my graduate work, define research-creation as:

> An approach to research that combines creative and academic research practices, and supports the development of knowledge and innovation through artistic expression,

> scholarly investigation, and experimentation. The creation process is situated within the research activity and produces critically informed work in a variety of media (art forms).[27]

Our four-part research-creation project, *Atomic Phonics*, accepts user input via the mouse, keyboard, and webcam to manipulate text displayed on screen. Each method of interaction relates the human/computer interface to the poem's form and semantic content. "Optic Poem," for example, converts the video feed from a user's webcam into characters from the word 'Optic.' The darkest regions of the image are represented by 'P's, while the lightest are blank; regions with intermediary brightness values are assigned to the other characters (see figure 12).

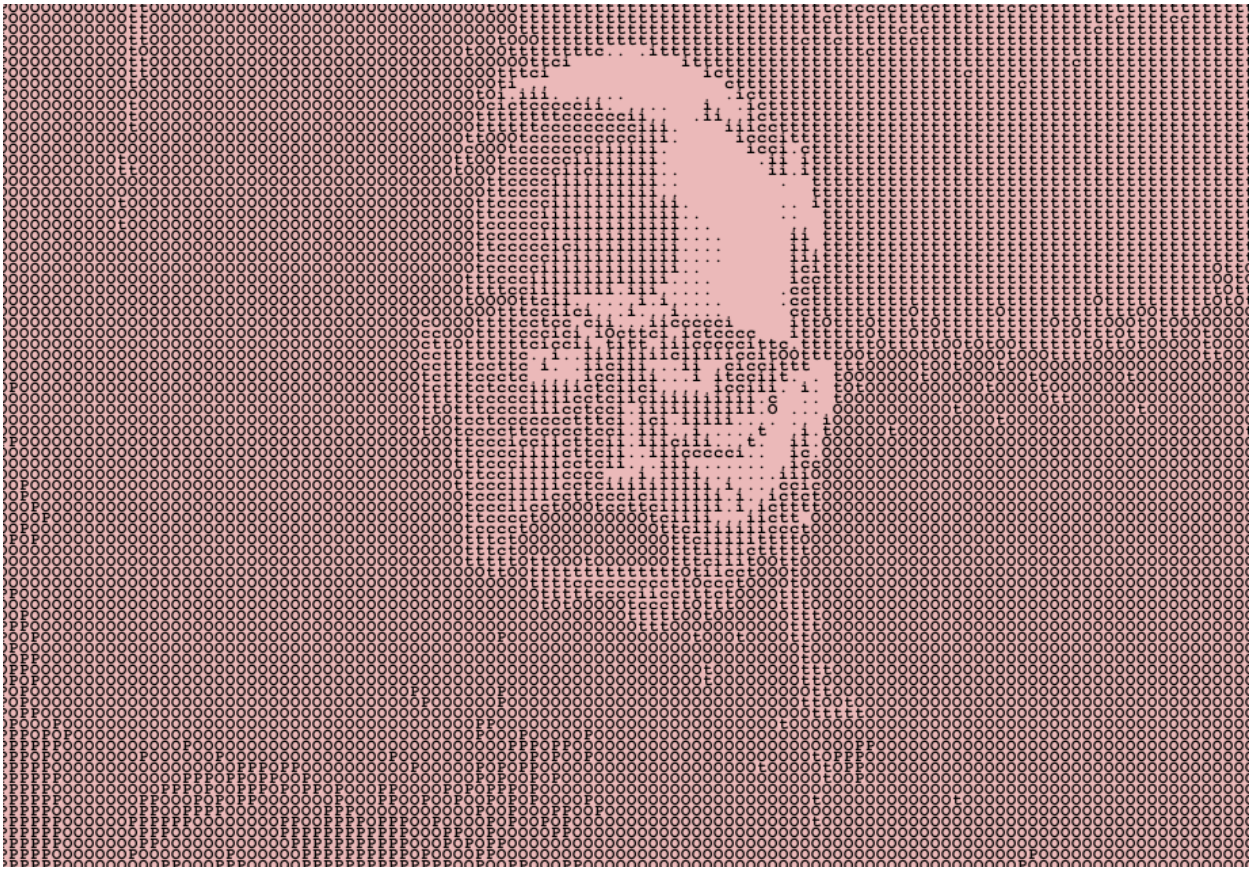

Figure 12. "Optic Poem" from *Atomic Phonics*, screenshot (Flemmer and Lynch).

[27] See "Definition of Terms" on the SSHRC website.

"Optic Poem" is inspired by ASCII art, a text-based visual art made by using computers to render images in characters from the ASCII character set. Just like typewriter art before it, ASCII art is constrained by the parameters of the machine, which define, for instance, the grid-like organization of monospaced text. I have typewritten hundreds of visual poems, and "Optic Poem" is an extension of my work in that form, but it is also a major departure in that, like all the poems in *Atomic Phonics*, real-time user interaction plays a pivotal role in the appearance of the poem. In the context of this study, *Atomic Phonics* constitutes research-creation in two ways: first, I was able to experiment with digital poetry as it relates to my ongoing creative practice, and, second, I have integrated lessons and experiences from writing a poetry program into my critical work. *Atomic Phonics* touches on many of the concepts I encountered while researching digital poetics—interactivity and reader agency, intuitive user interface design, distributed authorship, and so on—but it is the experience of research-creation, itself a transdisciplinary practice, which has most definitively influenced my idea of transdisciplinarity with respect to digital poetry.

It was not until designing *Atomic Phonics* that I began to consider the variety of skills needed to make a digital poem and the difficulty of cultivating transdisciplinary competencies in a compartmentalized learning environment. Taking a class in computer science was great exposure to subjects not covered by literary studies, but my main takeaway was not so much learning how to code in Processing as how to parse and synthesize ideas from different disciplines. I think of this skill as 'transliteracy', and it can be practiced and strengthened like any other. Media scholar Sue Thomas defines transliteracy for the computer age: "the ability to read, write, and interact across a range of platforms, tools and media from signing and orality through handwriting, print, TV, radio and film, to digital networks" (101). Transliteracy is not a new behavior, though Thomas claims it is only since the proliferation of the internet that critics have developed it as a working

concept. In a unified media ecology that requires both print and digital literacies, it is crucial to become fluent in the interchangeability of media. Transliteracy is thus more than the mastery of many modalities: it is the ability to respond to transmedial artifacts, to grapple with the chimeric, pluralistic nature of media that exists in code, on screen, and in print all at once.

Thomas argues that "[t]he transliterate lifeworld is highly subjective, diverse and complicated. It is not one kind of place, but many" (105). To keep abreast of literature as it operates in the digital milieu, literary studies will have to become more than one kind of place and support more than one form of literacy—a shift adjacent fields, like media studies, have already embraced. Henry Jenkins extends this imperative to all disciplines and schooling environments. In *Confronting the Challenges of Participatory Culture*, he remarks on the pressure to become more transliterate that young people feel growing up in an increasingly public and participatory culture. Jenkins identifies a wide range of interrelated skills for navigating the transmedial landscape, including collective intelligence, networking, multitasking, and distributed cognition, i.e., "the ability to interact meaningfully with tools that expand mental capacities" (xiv). Echoing Funkhouser, Jenkins maintains that the skills required for digital literacy are extensions of those readers cultivate for print literacy and should not be considered a revolution in our understanding of the contents of media. Rather, transliteracy responds to changes in the way we access and circulate information. My position throughout this study has been that materials and semantic content come together in the minds of readers, and so, to me, transliteracy represents the extension of pre-digital literacies and the readings it is possible to generate. Digital literary criticism is situated in a cybernetic milieu that requires critics to look beyond the poem as a singular artifact or experience and into the network of conceptual and material concerns behind it. This line of thinking prompts the guiding questions explored in Part 3: What does it mean for a literary milieu

to be cybernetic? What skills do readers need to analyze poetry in a transmedial world? How might we adapt critical reading practices to accommodate the changing conditions of contemporary media literacies?

Jenkins offers some concrete suggestions on what new literacy skills are needed and how to develop them, though my impression is that, to best incorporate these skills, it is necessary to add to our sense of what it means to read critically. Generally speaking, reading a poem critically involves moving past the surface-level meaning of the text to examine its claims, assumptions, ambiguities, and possible interpretations. The issues I've covered in preceding sections—computer mediation, transmedial artifacts, composite materiality, distributed authorship, etc.—require a transliterate form of criticism reimagined for use on poetry in a digital milieu, one beginning in the material and conceptual specifics of a poem then shifting focus to the cybernetic world beyond. Moreover, scholars like Spinosa emphasize reader interactivity and interpretive freedom in response to transmedial digital poetry; the more interactive a digital poem, the more agency readers have in the meaning-making process. I argue that reader freedom extends to the context of critical reception as well, irrespective of disciplinary boundaries. Informed by cyberfeminist and posthumanist theory, literary criticism becomes a transdisciplinary field that pays deference to pre-digital reading practices even as it embraces new ones.

Reading like a Cyborg

There are many curious and unexpected affordances for networked readers and writers. For example, interactivity and the growth of online audiences combine to breed what Flores calls transmedial storytelling, a collaborative literary endeavor that may span many platforms, networks, and user accounts. As for this growing community of transmedial storytellers, "[t]hey

may not even be aware that they are producing something that could be considered electronic literature," Flores claims ("Electronic Literature in 2016"). "The crucial thing is that people are increasingly creating, sharing, reading, and interacting with works that 'thrive at the intersection of digital media and textuality,'" thereby fulfilling the ELO's working definition of electronic literature under Flores' tenure ("Electronic Literature in 2016"). His assertion that transmedial storytellers may not be aware of the literary dimension of their work dovetails with the point I have already made about distributed authorship that numerous agents may contribute to the creation of a text with varying degrees of intentionality.

Distributed authorship also aligns with Schaefer's conception of literature as a "transmedial configuration or network," given that networks are made meaningful by the connections facilitated between nodes (169). Digital poetry is networked not only in the sense that it is hosted online or created using digital technologies, but in that transmedial literature is itself a network, the media of its transmission constituting the interrelated means of its expression. As Glazier puts it, "electronic poetry is a public word, projected across a public world, across systems, itself a system" (38). Approaching digital poetry analytically therefore requires readers to account for the networks or systems in which the poem is situated, and how these systems inflect its interpretation, particularly insofar as readers participate in the work.

The critical axis along which networked technologies alter digital poetics is that one leading from singular authorship to a form of distributed authorship wherein technology itself plays a determinative role in the creation of the poem. Of course, writing implements have always influenced the outcome of their issue, and yet, as Hayles argues in *Writing Machines*, digital technologies change our relationship to text in that "[c]onsciousness alone is no longer the relevant frame but rather consciousness fused with technologies of inscription" (117). This fusion lies at

the heart of Hayles' posthumanist philosophy and displaces the individual as the frame through which we interpret literature. The individual reader contributes to but only partakes in some of the overall meaning of a poem. This premise reminds me to question my interpretive position with respect to the technologies and materials I analyze.

If a networked configuration of agents leads from individuality to a distributed form of authorship, the same is true of a poem's networked materials. Materiality in the extended sense Munster identifies—i.e., the material conditions under which we produce and consume digital media—invokes the full distribution of resources at play in the cybernetic systems supporting digital poetry. I think of a poem's networked materiality as a kind of distributed embodiment, and I agree with Hayles that the digital extension of materiality constitutes a paradigm shift in the act of reading. In "Virtual Bodies and Flickering Signifiers," Hayles argues that the new paradigm privileges notions of access over those of possession in that "[i]nformation is not a conserved quantity" (84). Hayles writes:

> If I give you information, you have it, and I do, too. With information, the constraining factor separating the haves from the have-nots is not so much possession as access. […] Presence precedes and makes possible the idea of possession, for one can possess something only if it already exists. By contrast, access implies pattern recognition. ("Virtual Bodies" 84)

Access has already changed the way many computer programs are bought and sold, from video games to accounting software. The tech industry is moving from a sales model based on one-time, permanent purchases to a subscriber model based on renewable, limited-time licenses. What this means with respect to poetry is that, from the posthuman perspective, computer systems irrevocably change the way we read. The effects of new modes of reading extend beyond digital

poetry, coloring the way we interact with all texts. “As the effects of flickering signification ripple outward,” argues Hayles, “readers are trained to read through different functionalities, which can affect how they interpret any text, including texts written before computers were invented” (“Virtual Bodies” 90). To me, this means the mere existence of e-books and cloud computing forever changes our relationship to texts at a bodily level so that, even when reading Plato’s *Republic* from a printed book, one cannot help but read the allegory of the cave through cyborg eyes already accustomed to the light of a world beyond.

O’Sullivan stops short of the previous claim, warning critics against the assumption that all literature must now be considered digital. My position is that, at very least, all literature is drawn into dialogue with the prevailing technologies of our day; digitalism has marked what it means to read, and therefore marks all literature. I propose, following Cutting’s “Reading with/through Donna Haraway,” that literary critics use Haraway’s figure of the cyborg to broach the subject of embodied sociocultural networks—i.e., Munster’s extended definition of materiality—by reading poetry through communal relationality. The communal, sociocultural dimensions of poetry must be considered “because reading processes do not start or end with an isolated individual” (Cutting). From the cyberfeminist perspective, readers and writers have a responsibility to address sociopolitical issues as fully implicated in and instantiated by individual digital poems. Haraway refers to the entanglement and co-constitution of individual entities as sympoeisis, or making-with, “a word proper to complex, dynamic, responsive, situated, historical systems” (*Staying with the Trouble* 58). Digital poetry is just such a sympoetic system and, as a field, can be read as an embodied cultural response to the techno-dystopian present.

Haraway is optimistic about the potential for sympoetic cultures to thrive in the face of escalating social and environmental crises. Cybernetic organisms are hybrids of biology and

technology and, as such, they exist at a nexus of natural, social, historical, technological, and conceptual forces, embodying the entanglement of these forces. The figure of the cyborg is especially provocative insofar as it is a claim against; Haraway's cyborg is a feminist figure which claims itself against phallogocentrism, hierarchical authority, and the purity of origins. Cyborgs also make claims against common conceptual binary oppositions, challenging distinctions between humans and animals, organisms and machines, and physical and nonphysical entities. Haraway's erosion of the human category is, in my view, a posthumanist project, particularly in its co-opting of mechanistic entities. I conceive of my work as participating in this project as well in that I also seek to blur the boundaries of common conceptual oppositions: namely, those between readers and writers, poems and code, and analog and digital formats. Digital poetry complicates each of these binary oppositions. The wireless transmission of poetic data challenges the physical/nonphysical binary, while speech-to-text transcription defies the analog/digital opposition. Cyborgs take these dualities within themselves to demonstrate that we all are hybrid creatures, composites of biology, technology, socialization, and individual lived experience.

The lesson here is for critical reading practices to remain connected to material circumstances amid the myriad other conditions of artistic creation and reception, to remain aware of the ways form, material, content, and context feed into each other. For me, this means being on guard against accepting the purely digital or virtual as given. Haraway models this hermeneutics in *Staying with the Trouble*, ending her arguments about sympoeisis by addressing the confluence of factors leading to and expressed by four very different art projects, which she refers to as "science art activist worldings committed to partial healing, modest rehabilitation, and still possible resurgence in the hard times of the imperial Anthropocene and Capitalocene" (71). Haraway has chosen her cases specifically because they exhibit this commitment. I think it should

suffice for cyborg readers to ask if and how the works they encounter make similar commitments. For example, I noted the irony in Tucker's and Papachristodoulou's use of PLA to speak to ecological issues like melting glaciers and colony collapse disorder.

In "Reading with/through Donna Haraway," Cutting builds a strong case for the relevance of cyborgs to transmedial digital poetry, claiming that "to engage in literary criticism is to perform and constitute a particular technology of reading." If language qualifies as a kind of tool, as it does for Chomsky and other linguists,[28] then reading, Cutting suggests, must be a communications technology. I'll add that these forms of technology are complementary, relying on and developing alongside each other, though each has its own methods, objectives, and strategies which do not necessarily serve the interests of the other. Haraway's statement in "A Cyborg Manifesto" that the "silicon chip is a surface for writing" prefigures the application of her philosophy to literary criticism and digital texts (13). Though Haraway does not often address poetry directly, Cutting's essay links her work with contemporary literary criticism, foregrounding cyborgs as figures for "helping with articulat[ing]" the embodied web of power relations to which digital literary texts belong (Cutting). "A cyborg perspective sees through the anti-technological claim critiques of contemporary digital communication, and highlights that the literary text forms part of the web of power relations which makes those very technologies 'fully implicated in the world'" (Haraway, qtd. in Cutting). In my reading, the cyborg perspective neither condemns nor condones technology as it relates to literature;[29] rather, cyborgs are conscious of the double-edged condition of writing's co-constitution with and embeddedness in technology.

[28] See Part 1, "Code Imitating Life."

[29] I'm reminded of the glitching, infected neural prostheses in sci-fi novels like William Gibson's *Neuromancer* and Larissa Lai's *The Tiger Flu*, which confer great power and terrible suffering on their hosts in equal measure.

The inextricability of the individual from their social context and of society from the technology it both creates and depends upon means that we are all already cybernetic organisms, entrenched in a matrix of techno-social relations informing the very possibility of our being. However, I must reiterate Coady's caution against viewing these relations as essentially of one configuration or another. Capitalism, for instance, is not strictly essential for digitalism, though they are deeply linked. I feel this distinction is important when discussing cyborg figures in that there can be no orthodoxy of hybrid forms. Cyborgs are the epitome of formal heterodoxy. This posthumanist idea, according to Cutting, implies that all literature is cyborg literature; in fact, it always has been, including in oral cultures.[30] From the point of view that media augments human cognition, I can't help but agree. We are informed by our environment at the same time we exert influence on it, and technology is nothing other than the conscious refinement of that feedback loop. The notion that humanity as a category is discrete from nature and technology is challenged by the understanding that these categories evolved together and are wholly interdependent. Thus, the expression of poetry through any one of the many forms of digital media implicates the entire network of technological means and conditions.

Hayles proposes in "Virtual Bodies and Flickering Signifiers" that physical bodies are "a form of information transmission and storage that incorporates its encodings in a durable material substrate" (73). In so doing, she draws a parallel between the human body and the codex-as-body, each a physical record difficult to change once inscribed, and on this count humans have more in common with books than they do with computers. "Because they have bodies, books and people have something to lose if they are regarded solely as informational patterns, namely the resistant

[30] Folk tales, for example, may be shared person-to-person, but their narratives do not have a linear evolution; the "Fairy Tales" episode of *Explained* envisions a "golden chain of folklore that unites all of us" (21:53).

materiality that has traditionally marked the experience of reading no less than it has marked the experience of living as embodied creatures" ("Virtual Bodies" 73). Hayles argues that it is precisely because our bodies are sensitive to the nuances of interacting with poetic texts that we are also sensitive to changes in the information ecosystem that personal computing has brought about. Although digital embodiment may not be at stake in the world in the same way as human bodies or books, there are active feedback loops informing the way humans interface with computing systems. Hayles calls this nexus of influence: informatics, or "the technologies of information as well as the biological, social, linguistic, and cultural changes that initiate, accompany, and complicate their development" ("Virtual Bodies" 73).

I contend that the distributed, modular, and malleable embodiment of digital infrastructure is fundamentally unlike the resistant materiality of human bodies that Hayles describes. Nevertheless, distributed embodiment is a form of material entrenchment in real-world systems. The political and material stakes of this entrenchment are oftentimes exponentially higher than the interpretation of poetry. Consider how distributed embodiment changes the circulation of necessary resources like food and energy through every level of society. Consider also the weaponization of distributed computer networks enacting surveillance and state violence on human bodies through drone warfare, and the countermeasure weapons deployed against the distributed body of digital infrastructure itself, like graphite bombs that disable entire power grids. The cyborg milieu accommodates all these non-literary subjects by virtue of its digital materiality. Reading like a cyborg means asking how the poem on the screen in your hand connects to the rest of world through its distributed embodiment.

Poems in Extended Reality

Digital poems express their distributed embodiment through the impression of networked materiality they convey, prompting new methods for interacting with and navigating through their contents. I say 'prompting' because the great diversity of digital forms means there can be no preordained way to read digital poetry. Cyborg reading practices are therefore flexible and adaptive, responding to the material and conceptual conditions of each work in turn. Just as video games introduce new players to the specifics of their unique gameplay, digital poetry must oftentimes instruct readers in the mechanics of reading; the more novel the manner of interacting with a text, the more explicit these instructions tend to be. I find this is particularly true of poems made and read using extended reality (XR) technologies—an admittedly broad category encompassing, for example, real-and-virtual combined environments, wearable interfaces, and devices with positional tracking—especially insofar as they are differentially immersive and interactive. In "Light and Code," Fiona Becket describes XR poetry as having three characteristics distinguishing it from other forms of digital poetry: XR poems are predominantly immersive, multifocal, and multidirectional experiences (245). XR interfaces, including virtual, augmented, and mixed reality (VR/AR/MR) technologies, extend the human sensorium through augmentation, enabling real-world interactions with virtual assets. I agree with Becket that immersion is a defining feature of the field, though multifocal and multidirectional techniques are not exactly unique to XR poetry and, in my opinion, confer reader agency where sensory immersion tends to override it. Rather, multifocal and multidirectional techniques achieve diverse effects in XR versus other media, especially with respect to reader immersion and interactivity.

According to Milgram et al., instances of XR exist along a reality-virtuality continuum, with un-augmented reality at one end and full virtuality at the other (282). I assert that full or pure

virtuality is impossible because everything virtual ultimately depends upon the operation of physical systems; all instances of XR thus fall somewhere on the continuum between its two extremes. XR poems may employ virtual and real elements in any number of combinations and configurations, and so, as with other kinds of digital poetry, I evaluate work in XR according to its unique transmedial expression. These expressions are composites of physical and digital parameters and are therefore productive sites for cyborg reading and composite analysis as I define them above. When examining XR poetry from these perspectives, it is instructive to ask how the real and virtual are brought to bear on one another via these poems, and where the extension of one's sensory apparatus figures in. As demonstrated in Part 2 with respect to the multiple versions of a poem and their composite materiality, I argue that tensions between the various physical and virtual elements of an XR poem generate meaning in their own right. The following section takes up several XR poems, comparing and contrasting the relative effects of their position on Milgram's reality-virtuality spectrum.

I begin my comparative analysis of XR poetry with two browser-based digital poems invested with relatively limited degrees of interactivity and immersion. Though contained by a browser window, I consider browser-based applications to be XR if they construct an apparently three-dimensional virtual space within this framing. The virtual space, accessible to human readers by way of the device, represents a position closer to the virtuality end of Milgram's spectrum. "Aphiddd" by Andy Campbell is a three-part series of 3D digital poems featuring ghostly tendrils of floating text encircling decomposing tree-like forms (see figure 13). Organic textures etched with static words are photomapped to each of the three virtual models. The floating text surrounding the rotting logs is animated, winding in rings and loops around and through them.

Campbell foregrounds the themes of decay and parasitism in his introduction to the work, which sets up a fascinating tension between textual and organic elements:

> The poetry runs along ‘splines’ generated through primitive geographical [sic, presumably geometrical] shapes—mostly tori. These are sometimes stretched or overlapped to give a sense than [sic] the text is encapsulating or ‘suffocating’ the natural branches and bark sections. (Introduction)

Campbell presents language as at odds with nature; they have a vampyric relationship wherein language both feeds on and smothers nature. This framing interests me insofar as it makes an eco-political statement about humanity’s assault on the natural world. Artifice consumes nature through its translation into digital space. And yet, my impression of the dynamic between the words and the decaying logs is not so much one of constriction, but emanation. To my eye, the splines of glowing text are spectral projections radiating from and anchored to an organic body. In the second part of “Aphiddd,” the largest ring of text reads: “what a shame / that my body / shows no discernible marks / no worddds — only emptiness” (Campbell, “Aphiddd”). These textual spirits seem to haunt the matter they are bound to, speaking as the material body cannot, so I read this poem as depicting the intimate entanglement of culture and technology with physical reality.

Take a step back from the screen displaying “Aphiddd” and we remember this poem is not materially equivalent to a decaying tree, though it does take on the superficial appearance of real deadfall through digital photography and 3D texture mapping. Campbell captures imagery from the physical world and imports it into this virtual realm, framed by the browser window, and made navigable with simple mouse-based interactions: clicking and dragging rotates the model omnidirectionally around its center, while scrolling the wheel zooms the camera in and out. Each poem begins with its camera in a predetermined position, otherwise readers have full navigational

freedom within the limits of the zoom function, meaning “Aphiddd” can be viewed from any angle and from a range of distances. “Aphiddd” is about as interactive as the 3D vector models of Tucker’s *Loss Sets*; readers are free to choose the vantage from which they view the work, but have no control over the appearance of the poem otherwise. Alan Sondheim comments on *The New River*’s webpage, where “Aphiddd” was originally published: “wished there were more interaction, ended up enveloped by the beauty of the piece more than the language.” Each model is set against a dark, moody background with subtle lighting cues to help readers orient themselves in virtual space. The tone of the poetry is augmented by Barry Snaith’s ominous, ambient soundtrack. I agree with Sondheim that the interactive aspects of “Aphiddd” are outshone by “the beauty of the piece,” which I take to mean its high-quality texture mapping, background imagery, and soundtrack—i.e., those elements which contribute to reader immersion over and above mere navigational freedom—inviting readers into an aesthetic experience of the poem.

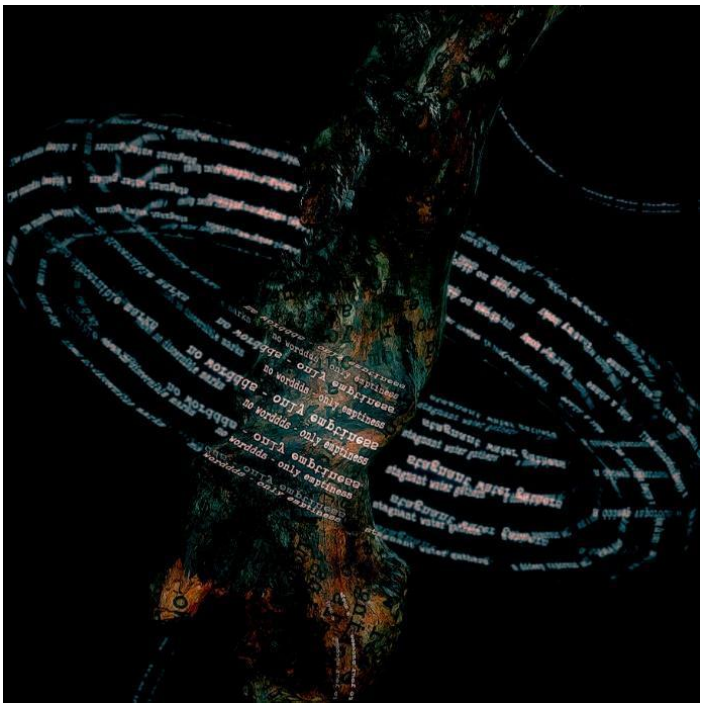

Figure 13. “Aphiddd” from *Dreaming Methods*, screenshot of second part (Campbell).

Figure 14. “In the Skin of the Gloam” from *V[R]ignettes*, screenshot (Breeze).

Campbell’s virtual poetry is closely aligned with the 3D modeling work of Mez Breeze, developing a similar dynamic between text and organic forms. Breeze’s “In the Skin of the Gloam,” part of her series *V[R]ignettes*, features text superimposed at strategic locations over a 3D model of a monstrous seahorse-like creature (see figure 14). Four simple mermaid-esque figures surround the creature, heightening the associative tensions built up between the words and the models. Clicking on a numbered location marker makes its corresponding text visible and orients the camera to a set position relative to the model. Once this focal point is set, readers are granted unrestricted rotational movement around that point, as in Campbell’s “Aphiddd.” Breeze does not, however, identify her work as digital poetry. She describes *V[R]ignettes* on her website as either XR literature or “VR crafted microstories” (“V[R]ignettes”). I feel the series belongs just as well in a study of transmedial digital poetry, so long as we are careful not to disregard Breeze’s

framing of this work as a series of stories, drawing our attention to the narrative imposed by the sequences of numbered locations. As Becket characterizes authors like Breeze: “The appellation ‘poet’ might be too restrictive with respect to these makers, and others in the broad field of computational poetry, literature more broadly, and design” (246). This does not mean cyborg reading ignores the conventions of pre-digital forms and genres; rather, it means reading through those conventions while remaining open to aspects of digital work for which they do not account.

“In the Skin of the Gloam” can be viewed either in a browser window or using a VR headset, thanks to rapidly-evolving programming standards for online XR device integration, also known as the ‘immersive web’. The WebXR Device API is an open specification for accessing VR and AR devices from a browser application. Open specifications are programming standards that aid in transparency and interoperability, allowing media hosted online to be cross-compatible with different kinds of hardware. *Sketchfab*, the database where *V[R]ignettes* is hosted, features WebXR integration, and when “In the Skin of the Gloam” loads in the browser of a VR headset, the application provides users with the option to view the model in VR. If viewed in a browser window, the *V[R]ignettes* 3D models are set against a background image, just like in Campbell’s “Aphiddd,” except with *V[R]ignettes* the background images are static. This minor distinction exerts a dramatic effect on the reader’s sense of position in virtual space. In “Aphiddd,” the orientation of the background image is fixed to the model, and when the model rotates, so too does the background. The model is stationary relative to the background, so it must be the camera or reader who moves. However, when “In the Skin of the Gloam” rotates, its figures spin against a static background of dark clouds; it is the model which appears to move rather than the camera. In the former situation, I read as though I’m circling an untouchable object, as one circles statuary in a museum. In the latter it’s as if I am the agent touching and turning the artifact. Breeze creates

the impression of both a moving camera and a moving model through the use of the numbered waypoints positioned throughout each scene. When clicked, these waypoints reorient the model while shifting the focal point of the display, thereby also repositioning the viewer. Though the navigational mechanics of these projects are nearly identical, *V[R]ignettes* feels more interactive in that it invests readers with slightly more agency over the model in virtual space.

The distinction I make between Campbell's and Breeze's work—i.e., between reader-as-observer and reader-as-agent—breaks down when viewing "In the Skin of the Gloam" in VR. Sadly, the background image is forsaken when reading from within the 360-degree virtual environment. The reader no longer looks through the browser window into a virtual space with an up- and downstage, as it were. Rather, an infinitely receding horizon surrounds the reader on all sides, so there is no longer a background on which to display a 2D image. Without this visual benchmark, all movements appear to be of the camera relative to the model, returning agential readers to the status of observers. Though experiencing *V[R]ignettes* in VR may seem more immersive than on a screen, the VR format lacks the aesthetic polish of the browser-based version. Perhaps this breakdown lies in the combination of hardware and software mediating my access to the project. It is possible that *Sketchfab* does not seamlessly integrate with the built-in web browser of the Oculus Quest 2 on which I viewed *V[R]ignettes*, causing the omission of its background images. Regardless, I feel that *V[R]ignettes*, like "Aphiddd," is best experienced in a browser window, where it achieves the most effective "activation of the reader as a participant [as] determined by navigational tools and the capacity of other computers to run and respond to the digital geometries of Extended Reality" (Becket 248).

At the other end of the XR spectrum are VR works, like "Phases of the Moon" by Simon Theis Hansen and "LoVR" by Aaron Bradbury, for which total immersion is either integral or

especially valuable to the reading experience. Both of these projects exist as short films which are readily available online and do not require a compatible VR headset, but immersive elements are lost without the ability to look around within the virtual space. “Phases of the Moon,” for example, takes the form of a labyrinthine web of text floating in 3D space (see figure 15). This poem tells the story of a romantic relationship fraught with misgivings. Readers ‘fly’ through the text by extending their arms in the direction they want to travel and pulling triggers on handheld controllers. A video recording of any one flight through the complicated arrangement of floating text can only hope to capture a small fraction of its semantic content. “Phases of the Moon” can be a little forbidding to navigate because of its complexity, and it is easy to get lost in the poem. The sensation of moving in the vertical plane at will thanks to a device strapped to one’s face recalls the disorienting feeling of scuba diving for the first time, and, like diving, there is a time limit on this experience: after about fifteen minutes, text starts to vanish.

Despite the complex arrangement of lines and the poem’s time constraint, Hansen empowers readers with a high degree of navigational agency, and therefore with a high degree of control over which segments of text they encounter and in what order. Freed from gravity and the limits of physical space, users can choose to follow lines of text along their length, reading them in order, or to fly through the poem, reading words as they pass by. Many of the lines evoke technological processes alongside the strained romance the speaker describes, for instance: “to secure the connection / between actions and words / my lover / my executioner / I paint you on the walls of my bedroom” (Hansen). The images of love as a ‘secure connection’ and ‘execution’ employ double meanings to suggest parallels between love and mechanical function and dysfunction. Furthermore, the importance of the “connection / between actions and words” and the representation of the lover in a symbolic space the bedroom directs my attention to the materiality

of the virtual environment. “Phases of the Moon” runs on specialized hardware and software designed to trick the human sensorium into perceiving VR as a fully immersive experience. Hansen employs an omnidirectional navigation style foregrounding bodily interactions with virtual space; it draws the reader into virtual space, placing them within the poem without denying its connection to the material world via their body.

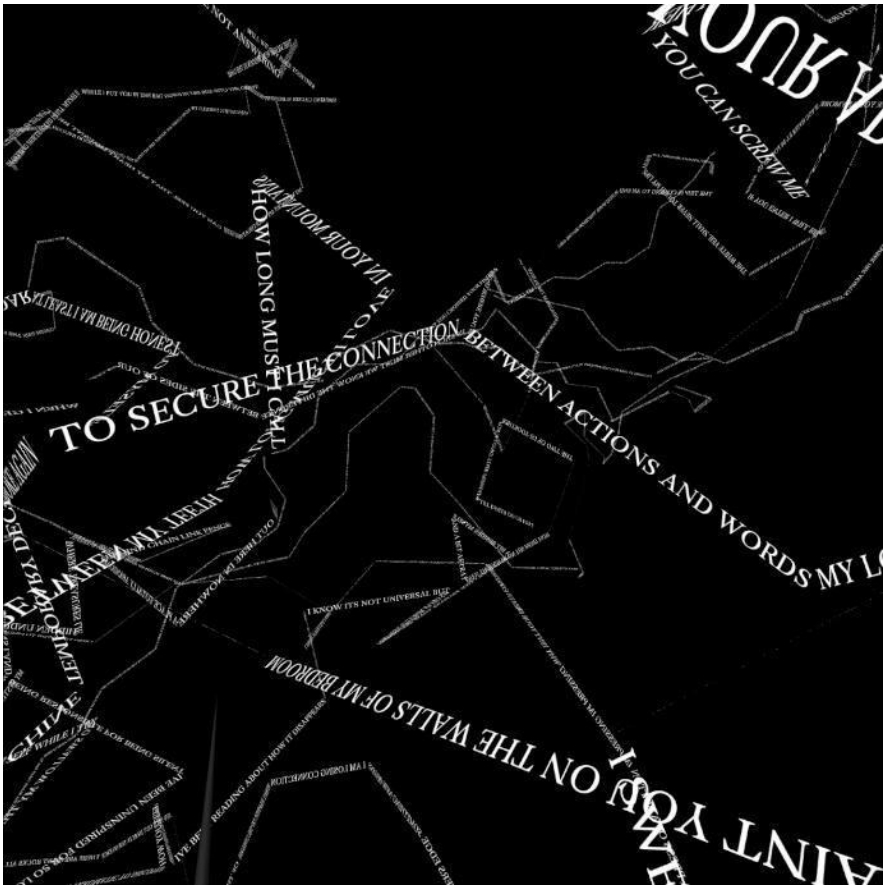

Figure 15. “Phases of the Moon” from *Quest App Lab*, screenshot (Hansen).

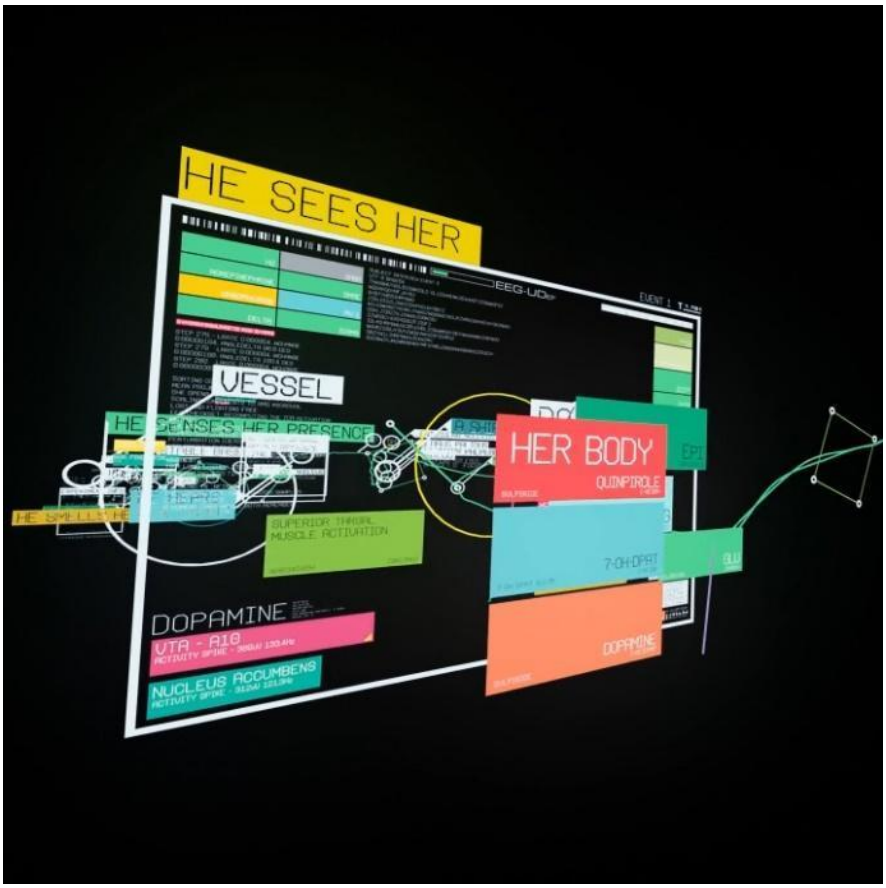

Figure 16. “LoVR” from *Within*, screenshot (Bradbury 1:25).

Even more bodily—in theme, if not interaction style—is the VR film “LoVR” by Aaron Bradbury. As with Breeze’s *V[R]ignettes*, I feel comfortable discussing “LoVR” as a kind of digital poetry in that kinetic typography and poetic blazon are prominent features of the work. Set to music by John Hopkins, “LoVR” introduces itself as a “data visualization […] produced using neural activity captured over 4 seconds [...] the subject describes this period of time as the moment he fell in love” (Bradbury 00:12–00:16). An oscillating green line reminiscent of the line on a heart rate monitor or EKG passes this introductory text. As it progresses, information about the subject’s biological and neurochemical state appears around the line in three-dimensional space. Soon, the subject senses the person with whom he will fall in love, a moment signified by an uptick in the

line's activity, and when "he sees her" at 1:25 the infographic notes a spike in dopamine (see figure 16). The reader moves alongside the data visualization as it accumulates, tracking steadily parallel to its increasingly erratic movements. The camera centers on the advancing line by default, so the action is always at center stage, but readers are free to look around the virtual space as they please. As the music and animation escalate with the neurochemical drama, information about the subject displays more and more rapidly, faster than it can be read. I find this experience highly immersive, despite the lack of interactivity relative to other XR poetry. While "Phases of the Moon" overwhelms the viewer with navigational choice, "LoVR" overwhelms through sensory stimulation, prompting the question: does overstimulation reduce reader agency through its domination of the senses? How does this relate to the bodily experience of love at first sight?

I argue that immersion and interactivity are separate axes on Milgram's reality-virtuality continuum. In the case of "Phases of the Moon," navigational agency promotes bodily immersion, while, in "LoVR," the denial of reader agency holds the body enthralled. Both Hansen and Bradbury explore the intersection of technology and love, but the latter uses the affordances of XR to simulate the irrepressible feelings caused by subconscious neurochemical activity that humans experience as love. "LoVR" reinvents the blazon—a catalog of a lover's physical attributes in verse—eliminating the metaphorical contrivances Petrarch and Shakespeare use to describe, and thus objectify, their love interests. Instead, Bradbury zooms in on the subject's involuntary physical responses. Rather than repeat clichés like 'her lips are red like roses' or 'her eyes shine like diamonds', "LoVR" combines the words 'her lips' with a boom in the bassline and 'her eyes' with a spike in visual activity. This blazon is gendered, but, for the most part, it cuts through the superficial rationalization of normative beauty standards, highlighting the neurochemical activity all people share.

I doubt that Bradbury intends “LoVR” to read like a cyberfeminist intervention in the chauvinistic trappings of the male-authored blazon. The project is this, to the extent I have described, and it also displays sensitivity to the ways subconscious biological impulses figure into cognitive processes like idealization and memory formation. However, “LoVR” does explicitly center the male gaze, indulging in scopophilic pleasure in the presence of a presumably female love interest. I say ‘presumably’ because, if this whole interaction takes place within four seconds, the test subject’s assignment of the feminine pronoun ‘she’ to the love interest must be a matter of perception and projection. If the pronouns of both the subject and love interest were gender-neutral, “LoVR” would be one of the most universal love stories ever told. As it stands, readers of this VR experience are along for the biological ride of love at first sight from a straight, male perspective. I say this not to disparage Bradbury or his work, but to show how the composite character of XR poetry opens it to readings an author’s original vision may not accommodate. However, cyborg readers take an active role in the construction of a work’s meaning, and multiple interpretations are encouraged. I have been arguing throughout this section as though immersion and interactivity are the primary features of XR poetry, but any number of other parameters might be considered central as well. For example, it might be worth comparing the durational aspects of “Phases of the Moon” and “LoVR” versus the recurring or timeless structures of “Aphiddd” and *V[R]ignettes*.

Mapping the Continuum

Elsewhere on Milgram’s continuum lies XR poetry appearing in real-and-virtual combined environments, or AR. Neither purely virtual nor entirely physical, AR enhances real-world objects and locations with computer-generated media or data systems. A common implementation of AR involves layering digital imagery over a live video feed for real-time user interaction, as in the

mobile game *Pokémon Go*, billed as an industry-changing game upon its release in 2016. AR applications are now commonplace, having found regular implementation in the video effects filters of many social media platforms, and they are more present than ever in contemporary literary endeavors. I say this as a reminder that, only a few years ago, AR technologies were highly specialized and inaccessible to most readers and writers. When Borsuk and Bouse published their book of AR visual poetry in 2012, they broke new ground for transmedial literature. *Between Page and Screen* is an interactive visual poetry project using augmented reality to animate poems in a virtual space anchored to the pages of a physical book. The book itself contains sixteen glyphs—markers, as they are referred to in the instructions for use, "inscrutable black and white figures" according to Ann Hamilton's blurb on the book's cover—each a minimalist QR code, which, when the online software registers them via the computer's webcam, activate a visual poem in the virtual space on screen. *Between Page and Screen* relies on networked sensory and display hardware, so you need both the printed book and a computer with a webcam to access the poetry. Readers position the book facing the camera, while on screen the computer overlays the live video feed of the book with animated poems springing from its pages.

Between Page and Screen is explicitly transmedial, and the dynamic it establishes between the book object, computer mediator, and poetic content invites many of the critical methods I've used so far with respect to hardware, software, navigational interactivity, bodily immersion, and the space of the poem, a miscellany of intersections necessitating a hybrid form of literary analysis supported by cyborg reading practices. The project immediately calls into question the act of reading. Where does reading occur: on the page, on the screen, or somewhere else? These poems must be 'read' by the computer before they exist in augmented reality, where human readers encounter them. The multi-step process of computer mediation suggests to me that the space where

reading occurs is not the page, and has never really been the page, but is instead a kind of augmented space produced by contact between the symbol-bearing surface of the text and a human mind. These overtones make *Between Page and Screen* a potent test case proving the usefulness of cyborg reading as a form of transdisciplinary literary analysis.

Before turning to the hard- and software involved in running *Between Page and Screen*, let us survey the poems themselves. Borsuk and Bouse's augmented poems can be organized into two groups: short, epistolary poems sent back and forth between the characters P and S, and visual poems drawing on words or themes from the first group. For example, the passage springing from the third glyph contains the word 'Scaramouch', while the ninth glyph produces an image of a shield with the definition of Scaramouch written on it. The letter-poems sent back and forth between P and S describe their tumultuous relationship, a cat-and-mouse game of wordplay ending in reconciliation: "What / are boundaries anyway?" (Borsuk and Bouse, fourteenth glyph). Most of the second group of poems are animated visual puns on their textual content. The second glyph produces a rotating ring of text reading "[…]SPINTOSPINPININTO[…]" on repeat (see figure 17), and the eighth glyph summons a long string of letters and numbers scrolling across the application window like a stock ticker: "BE$_{-2.41}$ TWE$_{-1.02}$ EN$^{+4.20}$ PAG$_{-1.14}$ E$_{-2.34}$ AND$_{-0.34}$ SCR$^{+.67}$ EEN[…]" (Borsuk and Bouse). In my reading, the alternation between letter-type and visual-type poems works to produce an awareness of the conceptual space in which both types reside.

Figure 17. *Between Page and Screen*, screenshot of second glyph (Borsuk and Bouse 11).

While displayed on screen, each poem hovers over the glyph visible on the page in the background video, anchored to it so that rotating or tilting the book causes the poem to rotate or tilt as well. Turning the page makes the poem explode into a flurry of letters. This surprising mechanic highlights page turning as a mechanism of interaction whereby individual poems are created and destroyed.[31] When using the book in tandem with a computer and webcam, readers of *Between Page and Screen* develop a tangible sense of the spatial relationship between the page and its virtual projections. Physical interaction with this augmented object draws readers' attention

[31] See Lisa Robertson's *Nilling* for a fascinating mediation on the conceptual spaces of open versus closed books.

to the existence of a conceptual space abstracted from the text by the reading mind, returning us to the question of where reading takes place, if not the page or the screen. As the narrative resolves toward the end of the book, S declares: “Page, don’t cage me. Why this mania to name what’s between us? […] We share text’s fleshy network” (Borsuk and Bouse, twelfth glyph). Borsuk and Bouse locate the common ground between page and screen in a union of flesh and connectivity, organism and information, mind and device. A cyborg reading of *Between Page and Screen* acknowledges this union, then moves on to consider said device so as to better understand how it enables reader engagement with the content of these poems.

The poems of *Between Page and Screen* need many layers of technology and material resources to produce the conceptual space where they operate, to display and animate them on screen for human viewing. According to the project website, the physical component was originally produced in an edition of 12 artist books, each of their 100% cotton pages printed using photopolymer plates on a Vandercook proof press, then hand-bound and exhibited with the requisite input and display hardware and augmentation software. *Between Page and Screen* is now in its third commercial edition. Siglio Press released the first widely distributed edition in 2012, and I have a copy of the second edition, which SpringGun Press published four years later. My edition has no printed text on the front cover; title, byline, and decorative elements are debossed into the cover material, recalling the original letterpress edition, which bears imprints in each page from the photopolymer plates. Management of the website component seems to be left to the authors as it has remained relatively unchanged through commercial editions, and though the book appears to still be in print, the book alone is insufficient to access the poetry. In addition to personal electronics like a webcam, computer, and display terminal, *Between Page and Screen* requires network infrastructure like a router, modem, and internet connectivity, plus software including

Adobe Flash Player and several mediating layers of machine language. What's more, all the above run on electricity. It may seem trite to remark that electronic literature requires electricity, but, as media theorists like Kittler, Glazier, and Munster assert,[32] it is worth noting all the various systems we may be taking for granted in our consumption of digital poetry.

Besides Flash, *Between Page and Screen* uses a variety of open-source software, including: FLARToolKit, a Flash ActionScript that recognizes visual markers from an input image, calculates the camera position and orientation in 3D space, and overlays virtual graphics on the live video image; RobotLegs, an application development framework for writing in Flash ActionScript, itself a programming language specifically for website animation; Papervision3D, a graphics engine for rendering 3D content within Adobe Flash Player, communicating visual instructions directly to the computer's GPU; BetweenAS3, a tweening engine for animating smoothly between keyframes generated from data produced by the graphics engine; and JigLib, a physics engine providing an approximation of physical systems used to animate the poem. This list demonstrates how collaboration in digital poetry goes well beyond the authors debossed on the cover of the book. Though arguably true of print-based poetics, which rely on forestry companies to harvest trees to make paper, and so on, the distributed and durational aspects of digital materiality amplify the scope of collaborative influences we might read into a poem. Borsuk and Bouse use open-source software developed by tech companies, freelancers, grad students, and hobbyists—dozens if not hundreds of people, too many to name—and so the authors list the software they used on the project website and make their own source code and core library available. Similar acts of disclosure are relatively common among digital poets, whose work could not exist outside a network of

[32] See Part 2, "On Digital Materiality."

conditions, both conceptual and material, or without the people supporting that network. In my opinion, ongoing referral to this network of people adheres to a cyberfeminist ethics of reading.

The interrelated dynamics at play in *Between Page and Screen* make it ideal for analysis through posthuman and cyberfeminist critical lenses. At the level of the individual reader, the project recalls Hayles' literature-inflected posthumanism, how the "metaphoric associations put into play by the device's physical form include traffic between machine and biological organism" (*Writing Machines* 23). *Between Page and Screen* draws readers' bodies into an explicit relationship with computer hardware in order to activate each poem. Readers manipulate the book with their hands to present a printed glyph to the machinic eye while also watching the overlaid video feed displayed on screen. Proprioceptive engagement, i.e., how readers position their body relative to an object, has an important, if subconscious, determinative effect on the interpretation of that object. Making the AR projection function properly can be awkward, depending on the arrangement of one's body relative to the hardware, sometimes leading to a less-than-seamless viewing experience. The promotional video for *Between Page and Screen* makes the interaction between the book and webcam look extremely simple, and in particular circumstances I am sure it is. In recording my own video of the project in anticipation of the obsolescence of Flash, I found it was nearly impossible to navigate through the whole book without any recognition errors or interruptions in the animation. Comparing the video I made to the promotional one on the website is almost comical, even given that advertised promises are always at odds with reality. It is not the content of the poetry which governs these very different experiences of the work, but the arrangement of circuits and sensors with respect to paper and flesh.

On a social level, *Between Page and Screen* encourages what Cutting describes as a "cyborg ethics of reading," a posthumanist literary practice as entrenched in feminist ethics of care

and community as it is in technological hybridity. The cyborg critical perspective is realistic about the problematics of technology while treating technology itself as value-neutral, situating the object of analysis in its techno-social context. Framed this way, it's easy to see why Cutting argues that all literature is cyborg literature, and, given what *Between Page and Screen* has to say about the conceptual space where reading occurs, that it always has been. Taken alongside Schaefer's view of literature as a "transmedial configuration or network" (178)—wherein digital poetry is networked not only in the sense of its being hosted online or made using digital technologies, but in that poetry and languages themselves are conceptual networks—the reality-virtuality continuum is merely a recent addition to the multidimensional field of mixed real-and-virtual poetics. Cyborg reading practices are therefore uniquely positioned to respond to the distributive, networked aspects of both digital and pre-digital texts.

Virtual Venues

So far in this chapter, I have made much of the opportunities for readers to interact with, alter, and variously interpret digital poetry to a degree not possible with pre-digital media. To some critics, interactivity seems to come at the expense of the author, who must relinquish a portion of their creative control to the computer and their readership. Spinosa, for one, advocates for this creative divestment:

> I can perhaps fracture to at least some extent the authorial power afforded to the writer and especially the critic. The aim is to encourage reading practices that allow greater freedom to the reader, greater reader intervention, and greater reliance on machines, codes, and other non-human material to do the writing itself. (*Anarchists in the Academy* xxxvii)

Both readers and writers participate in shifting the balance of authorial power toward the reader, and I agree with Spinosa that agential reading practices, like cyborg reading, are preferable to those which surrender responsibility for all of a poem's meaning to its author. On the other hand, while an author may quite willingly minimize their direct control over the poem, I disagree that this minimizes their creative agency with respect to readers or machines. To my mind, the authorial control necessary to plot a course for readers to follow is not all that different from the control involved in defining a field for readers to make their own way through. "[W]here readers once relied on authors for the content of story," O'Sullivan writes, "they must now, in effect, rely on authors for the entire textual construction" (78). Put another way, readers of digital literature may be able to choose their own adventure, but authors construct the available choices and resultant adventures nonetheless deliberately. Point being, like many other parameters of digital poetry, interactivity is a spectrum more than it is a black and white issue. Reader freedom is wonderful, but it is only the author's responsibility insofar as interactivity is appropriate for their project—in my view, any freedoms not granted by the author can be claimed by readers themselves through remixing, hacking, pirating, etc.—all is permitted, though all need not be permitted by the hand (or code) by which it is rendered. In fact, poets who enable every possible interaction deny readers the opportunity to intervene in or transgress against the work. In my opinion, true postanarchist, anticapitalist scholarship reflects a readership prepared and proactive in taking radical freedoms into its own hands.

O'Sullivan pivots the discourse away from revolutionary speculation and toward an evolutionary—i.e., dialectical—model of development, spurring critics to reconsider their assumptions about the revolutionary power of electronic literature. For instance, he challenges the agency that digital methods seem to promise readers, arguing that "[e]lectronic forms can give the

appearance of freedom, but *no medium can transcend fixity*" (81, emphasis O'Sullivan's). Computers offer the appearance of infinite permutations through increasingly complex operations of procedural generation, yet every possible operation is pre-determined by the system devised by the author/programmer, both by the code underneath the text and the hardware underneath that, at least to the extent of the poem's operational requirements. In response to Hayles' notion of the flickering signifier, I argue that there only appears to be a severance in the one-to-one connection between signifier and signified we are accustomed to in print. The direct causal links are all still there, though submerged under a user interface providing an apparently endless array of choices. O'Sullivan refers to the illusion of infinite choice as the "digital sublime," a feeling further dissociating users from the material processes underpinning their interactions with computers (82). Rather than through generative participation, O'Sullivan argues that reader freedom is actually mobilized at the level of interpretive autonomy. Of course, interpretive freedom is an indispensable aspect of reading in general, and thus the constraints of digital media cannot constitute a poem's message in and of itself. Author, medium, content, and reader all come together in the meaning-making process, and it is the parameters of each individual work which determine how that coming together takes place. Multiple interpretations are natural in a pluralistic, cyborg milieu, and are consistent with the cyberfeminist reading practices I am advocating for.

Even in a highly digital environment, literary critics frame reader interaction, immersion, and interpretation as materialist systems of exchange. By this I mean that criticism in general treats literature as though authors write and publish books of poetry or VR films or whatever else, and readers encounter those artifacts out in the world, then interact with and interpret them. I will admit to adopting this stance as my default position thus far, but it cannot account for one common way people encounter poetry: person to person, in public spaces, directly from the poet. Analysis that

foregrounds poetry as an artifact tends to forgo consideration of poetry as an ephemeral experience, precluding in-depth engagement with spoken word, sound poetry, dub poetry, and other oral or performative forms of poetry; forms, I might add, much more closely related to the origins of poetry as an art form than any written text. Readers are immersed in poetry by being present for it, sharing space with the author as the poem unfolds in real-time. As someone who has organized and attended dozens of poetry readings, I can attest that the social dynamics at public events add to and change my interpretation of a poem. The physical presence of the audience might encourage or intimidate the poet, changing their performance for better or worse, just as a crowd might influence the attitude of an individual audience member by booing or cheering. One of the consequences of the COVID-19 pandemic is that most literary events are now held online and usually involve some combination of videoconferencing, live-streaming, and pre-recorded content. Online events have their advantages—they have built-in accessibility features, like auto-captioning, and participants can join from pretty much anywhere—but they fall short in some ways as well. I have found that it's especially difficult to foster an experience of presence in an online modality versus at an in-person event.

XR technologies offer a novel alternative to the problems of presence and immersion in the absence of a shared physical space. VR has already been used by some inventive poets as a live performance venue, bringing audiences together in a range of participant/observer configurations. On September 25, 2020, Jiaoyang Li and Jinjin Xu delivered "In America, Why Leaves Are Green?"—a live VR performance of spoken word poetry and video art—using Frame VR, a browser-based meeting and exhibition space. The performance features reverberating vocals spoken over top of a chaotic mix of visuals cycling on multiple projection surfaces at various positions and orientations throughout the virtual space (see figure 18). These are set against a series

of background images enclosing the space on all sides. Attendees logged in to the virtual meeting are present as avatars, projected into the multi-user space and visible to each other in VR. Avatars appear in the position each attendee is viewing the performance from in first person perspective on their own device.

Figure 18. “In America, Why Leaves Are Green?” from *YouTube*, screenshot (Li and Xu 10:26).

Frame is cross-platform and works from a web browser on computers, mobile devices, and VR headsets without the need to install it. Besides the active audience present in the virtual space, passive audiences were able to watch “In America, Why Leaves Are Green?” as a live-streamed event on *Twitch* and *YouTube*, where I watched a recorded version several months later. Li and Xu performed “In America, Why Leaves Are Green?” for the 2020 B.O.N.D. International Virtual

Live Performance Festival, which included virtual panel discussions, interactive workshops, and other XR-based arts events. B.O.N.D. Festival emulates the real-world coming-together of participants and attendees at a conference-like event, the goal being "to break the isolation in the post-covid [sic] era and set up a virtual stage for artists and spectators to feel and share with each other" ("About us"). The use of a virtual meeting and exhibition space foregrounds the presence of the viewer in the poem—even to passive and subsequent audiences, for whom the active and present audience is visible via their avatars in virtual space—dissolving to some extent the separation of digital readers and writers.

Irrespective of the barriers it transcends, virtual presence is not without its conceptual drawbacks. Han claims that the existence of a public forum in digital space forces the public to desire a move beyond the need for mediators in the representation of its interests. "General demediatization is putting an end to the era of *representation*. Instead, everyone wants to be *present* personally and directly—to *present* his or her opinion without a middleman. Representation is giving way to *presence*, or *copresentation*" (16, emphasis Han's). Co-presentation occurs in digital space, thus while the visible traces of mediating interfaces are reduced with digital technologies, mediation itself increases exponentially. Consider the comparative sophistication of the infrastructure necessary to send a letter, telegram, phone call, and tweet. Vast telecommunications networks combine with the social embeddedness of consumer electronics to facilitate the feeling of copresence we desire. Digital technologies obscure the mediation they provide, building a false sense of connection into user experience while encouraging the isolation and alienation that Han fears.

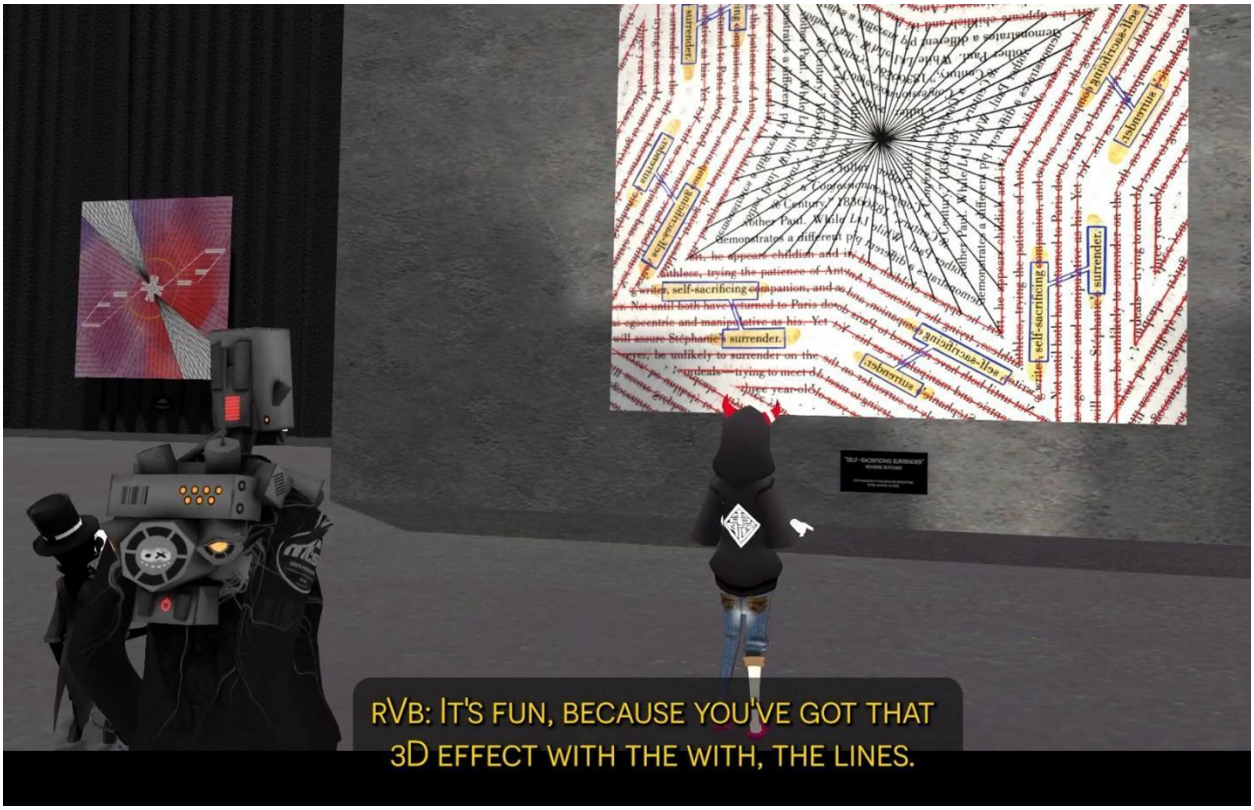

Figure 19. “Kaleidoscopic Erasures | VR Art Gallery Video Tour” from *YouTube*, screenshot (ReVerse Butcher 15:05).

In my opinion, virtual events are not quite capable of filling the gap left in our literary communities by the lack of in-person events. Rather, successful virtual events seek not to replace real-world experiences of community and presence, but offer literary experiences that are not possible without digital augmentation. Digital and visual poet ReVerse Butcher makes exceptional use of the various media formats it is possible to exhibit in virtual space. The launch of her visual poetry book *Kaleidoscopic Erasures* was celebrated on February 19, 2022 with a guided tour and visual poetry exhibition in the VR gallery she constructed in VRChat, an online virtual world platform (see figure 19). *Kaleidoscopic Erasures* is a series of collage poems made with a combination of traditional and digital techniques. ReVerse Butcher uses digital image processing

to apply multiple axes of symmetry to a printed text, creating “hyper-textual mandala[s],” as she describes them in the gallery tour video posted to *YouTube* a week after the launch event (5:11). This video gives viewers a sense of the live event and exhibition in VR, but it also includes elements specifically for the video version, like close-ups of visual poetry, making-of documentation, and voice-over narration. It is simple for organizers of virtual readings—whether delivered synchronously, asynchronously, or some combination of the two—to record and post a video of the event for later viewing. ReVerse Butcher takes the transmedial affordances of virtual event modalities to new levels of integration, proving that transmedial digital poetry and the XR hybrid event format can literally be made for each other.

Widening our scope a little further, I argue that cyborg milieus extend beyond virtual spaces as venues for creative performance and exhibition and into the communities forming the basis of creative practice. In Part 2, I introduced the concept of distributed authorship, the idea that we might consider every programmer involved in coding the software needed to read or write a digital poem as its co-author to some degree. Cyborg reading views the digital milieu as a site of virtual community, a network of agents and co-constitutive factors which contribute meaningfully to readers’ interpretations of digital poetry. To my mind, there is a gratifying parallel between virtual communities made up of creative people and the use of XR tools for artistic expression in that both the community and these tools exist at the intersection of material and virtual worlds, where transmedial poetry flourishes.

A Glitch in the System

Despite their processing power and apparent polish, computers are not infallible, and cyborg milieus do not operate seamlessly. Hard drives break down, data packets are lost, and signals get distorted. Malfunction can indeed be generative, and unpredictability and glitch can work in favor of embodied poetic expression by returning readers' attention to the materiality of the poem, but what about when errors disrupt access to or terminate a digital poem altogether? What are readers to make of the ephemerality of computing systems, subject as they are to obsolescence and deletion?

To test these questions, we must establish what 'perfect operation' means in a digital sense, as this is the standard against which glitch and error are legible. I am struck by Golumbia's point in "Characteristics of Digital Media" about the perfect copying of digital files, despite factors such as data compression, corruption, and so on:

> [I]t is vital to distinguish lossy copies of analog media from the perfect copying of digital objects, including digital versions of analog objects. Computational processes themselves would be impossible without the perfect copy; many everyday textual and media operations, both production and reception, would be either impossible or radically altered if the producer and consumers could not be certain that each version of the object was not the same as all others.

Golumbia characterizes perfect digital operation as the flawless correlation between a sequence of symbols and the behavior of the physical system. Assuming the reliability of the hardware, every iteration runs exactly the same. This definition is useful in that it describes ideal behavior, but it is also reductive, as Sayers implies when acknowledging the labor involved in setting up and maintaining technological resources:

> In the humanities, the maintenance and care of projects are usually performed in the labs, libraries, offices, and centres central to our research yet so difficult to trace through our publications and other scholarly communications. This everyday labour is rarely recognized (let alone considered scholarship), and it is increasingly integrated into contingent positions. (3)

There is tension between Golumbia's perfect digital operations and Sayers' portrait of the normal lifecycle of digital devices as mechanical equipment. Perfect copies take for granted all the material conditions of the cyborg milieu, where breakdowns might occur at any level.

One such breakdown is in the online component of Borsuk and Bouse's *Between Page and Screen*, which stopped functioning in 2021 when Flash became defunct. Without this multimedia platform and its associated application programming interfaces (APIs), *Between Page and Screen* can no longer load in my web browser. Flash was particularly useful for interactive, web-based media applications and was nearly ubiquitous in web design from my childhood in the '90s until the rise of HTML5 in the early 2010s. As a kid, the treasure trove of free-to-play, user-submitted Flash games on websites like *Newgrounds* and *eBaum's World* inspired me to make my own animations using video game sprites downloaded from the internet—I even took a summer course to develop my Flash animation and coding skills—so I was dismayed to learn that all Flash functionality would cease on January 14, 2021, a few months into my research on *Between Page and Screen*. Adobe's reasoning: not only does HTML5 make the animation functions of Flash redundant, the platform did not adequately guarantee users' data privacy. Not to dramatize the situation overmuch, but Flash's retirement felt something like the destruction of a library; I lost access to not only a subject of this study, but to the entire online archive of Flash media so important to me as a child, and which I never imagined would or could be decommissioned.

One of the first tasks I set for myself when beginning this research was to find alternative ways to access or preserve *Between Page and Screen*, given that Flash was soon to become extinct. I used a screen recorder to capture a video of myself interacting with the AR poetry while the platform was still operational, and I took screenshots of individual poems so I would at least have access to the their contents. Manipulating the book so it can be read by the camera is an experience-defining feature of *Between Page and Screen*, in my opinion, but screenshots of the animated poems were a good start toward documenting the poem for research purposes. I looked into emulators when Flash went offline and attempted to install Ruffle, a recently-developed third-party Flash Player emulator written in the Rust programming language. Ruffle was not yet compatible with my browser when it was released in early 2021, so I wasn't able to test it on Borsuk and Bouse's application until the emulator was updated. I eagerly installed the browser extension when Ruffle finally was compatible, only to find that ActionScript 3 (AS3), the version of ActionScript *Between Page and Screen* is built on, is not yet supported by the emulator. According to Daniel Jacobs, a contributor to the Ruffle code repository on *GitHub*:

> Ruffle is essentially redesigning the entire programming language interpreter that made Flash games work using Rust. Considering AS3 support was being added onto from 2006 (when it was created) to about 2018 (when it stopped being supported), that's over 13 years [sic] worth of APIs and core functionality that needs to be exactly recreated using Ruffle […]. That takes a significant amount of time to recreate, even with the benefit of knowing how things should theoretically work. (danielhjacobs)

As of this writing, the developers of Ruffle have not announced a timeline for AS3 support. Meanwhile, the absence of Flash feels like the end of an era to me, an end with widespread consequences for the media I grew up on. Some of this material has been remediated, ported to

other systems, emulated, or otherwise preserved. Jason Scott is a vocal advocate at the *Internet Archive* for the preservation of Flash-related materials. Previous versions of Flash Player are available for download from the archive, and with a little tinkering it is possible to make them work with legacy browser software. However, this requires users to download old software and figure out how to use it on a contemporary system, and so the *Internet Archive* has integrated Ruffle into its Emularity framework, which connects users to archival materials via third-party emulation software, "letting a subset of Flash items play in the browser as if you had a Flash plugin installed" (Scott). As such, the *Internet Archive*'s ability to collect and run software online relies on a huge community of programmers, web developers, and content contributors whose labor is less apparent the more seamlessly the system operates. The fact that even a subset of the *Internet Archive*'s Flash-dependent materials are accessible with no more than a browser makes me hopeful that even more Flash applications can be recuperated and maintained in an ongoing way.

Obsolescence plagues not only creative content, but critical writing as well. During the early stages of my research, I was unable to make the "Web Supplement" to Hayles' *Writing Machines* open in my browser, again due to the mothballing of Flash Player, though I was unable to determine the problem at the time. The online assets of the Mediawork Pamphlet Series, including those for *Writing Machines*, are hosted on the MIT Press website, where I assumed they would remain accessible permanently, given the tech-savvy reputation of the publisher. Fortunately, the *Writing Machines* "Web Supplement" must run on ActionScript 1 or 2, because installing Ruffle has restored access to the application. This "Web Supplement" features an index, bibliography, errata, notes, and a 'lexicon linkmap' or hyperlinked glossary, all interactive and offering alternative mappings of the book's conceptual terrain through functionalities unavailable

in print.[33] While I wish I had been able to access the supplementary material with the ease promised by champions of digitally-accessible scholarship, I'm grateful for an emulator that closes the gaps left by Flash, at least to some extent. That said, the inconsistency of access to online resources has led me to add precautionary measures to my research methods, like saving local copies of important resources and regularly updating my date of access records. Even though MLA style no longer stipulates date of access information on the Works Cited page, I think it is worth including the most recent date I accessed the material, given that some of these resources either no longer work or have only recently come back online.

I encountered obstacles besides the end of Flash while conducting this research, and not always of a technical nature. The pandemic made resources and spaces normally available to students at the University of Calgary inaccessible. I was eager to experiment with the 3D printers in the university's LabNEXT Makerspace after Tucker sent me a printable model from the *Loss Sets* series, but sadly it was closed. I did get my hands on a print of "Loss Set 2" (thanks to the generosity of Baker at the TFDL), but I wasn't able to take the Makerspace orientation or 3D-printing tutorial. When LabNEXT reopened in early 2022, I signed out a VR headset, an Oculus Quest 2, and brought it home to experiment with. Oculus gear requires a Meta account and a fair amount of setup from factory settings in order to use, so I spent a chunk of the loan period just getting the device to run. Once set up, I realized only some of the content I had planned to try would be available through the app store on the headset or compatible with its built-in browser. Like Apple with respect to the iPhone, Meta sanctions what is available through its official app

[33] Hayles, designer Anne Burdick, and the Mediawork editors allowed the sensibilities of the "Web Supplement" to inform the design of the book, and vice versa. Terms featured in the online lexicon linkmap are underlined in the book like hyperlinks, but the endnotes only appear in the "Web Supplement," as though the online component were the back matter of the book. Almost every section of the "Web Supplement" is offered as a 'technotext'—a PDF file/printable book insert—and many can be read as a browser-based 'plaintext'. These are only a handful of the transmedial features elevating *Writing Machines* to the status of literary artifact in its own right.

store. Fortunately, unlisted applications, like Hansen's "Phases of the Moon," are downloadable from the *Quest App Lab*, and user-submitted applications can be sideloaded—i.e., transferred from an unsanctioned web source—via the *SideQuest* content platform with the headset put in developer mode. By the time I figured out how to do all this, it was time to return the headset to the Makerspace. The library has finite resources at its disposal, so there are understandable limits on the XR experiences LabNEXT can facilitate, particularly during a pandemic.

I have already described the experience of registering for a class outside the Department of English and my campaign to get the Creative Computing course scheduled, but it's fair to characterize some of the institutional requirements for securing these privileges as barriers to access, especially the need to justify transdisciplinary studies overmuch. I'm lucky I was able to secure the minimum number of registrants to have Creative Computing scheduled, and I wonder how many students were interested in the course, but felt they could not justify enrollment to their department. The Creative Computing class and the research-creation opportunity it afforded me were invaluable for thinking through subjects addressed in this study from a hands-on perspective. Somewhat ironically, and after everything it took to perform this research-creation, Lynch and I could not figure out how to export *Atomic Phonics* for use as a stand-alone application. Our interactive poetry program does not run on computers without the specific Processing IDE and programming libraries we used; it needs to be compiled into an executable application for us to share it. Disheartened, we gave up on exporting our program until Processing version 4 was released, which by some twist of fate has fixed the problem. Though still in beta testing as of this writing, the updated Processing IDE and video library allowed us to successfully compile *Atomic Phonics* for stand-alone use on Windows operating systems.

My perception of the obstacles mentioned above are colored by a personal involvement in the field, but I imagine to some extent they are emblematic of digital poetry's ever-changing hardware, software, and media environment, where literary critics must assess their subjects. More than once an option I thought I could no longer pursue became available, and vice versa. In the case of *Atomic Phonics*, I learned of its exportability only a few months before completing this study. Perfect operation in this setting is both required and never guaranteed. Where does this leave critical discourse, which relies on the ability to confirm a scholar's findings? How do the limitations of the cyborg milieu impact upon digital poetry, and therefore on the way we read it? First and foremost, I argue that cyborg readers look for the tensions between conceptual limits and material limits, aware of how the former are grounded in the latter. Though seemingly infinitely extensible, digital networks are built and maintained using a network of real-world resources, which I think of as a form of distributed embodiment. McLuhan, for one, thinks that the boundless interconnectivity of electronic cultures leads to a collapse of the fervent individualism that underwrites consumer capitalism. However, McLuhan fails to realize that access to technology remains in the hands of the powerful, who distribute it only on terms beneficial to themselves. The highly individualized world we live in is nothing like the one McLuhan envisions, central though he is in our scholarship on media. O'Sullivan is much more realistic, reminding literary critics that "[n]ot all people are equally digital" and to avoid universalizing their experience of digitalism (7).

McLuhan's oversight opens on a second unseemly truth cyborg readers do well to remember: the fact of political, military, industrial, and commercial pressure on our daily interactions with computer systems. Capitalist insistence on software as a "commercial or American medium" produces what Kittler describes as "tragic conditions" for intellectual freedom. Emerson castigates Apple for driving a very specific kind of interface ubiquity, one that hampers

creative expression through the suppression of users' choices. Poibeau expresses concerns about the quiet involvement of military and intelligence organizations in the machine translation industry. These groups generate over half of all revenue in the industry, given their need to rapidly deploy screening and translation systems into niche surveillance situations, which is to say they spend lots of money on the clandestine interception and interpretation of transmissions sent and received by minority language groups (225–26). These and other real-world pressures exert tangible effects on digital poetry, as in Tucker's *Loss Sets* and Papachristodoulou's "artificial honeycomb," which openly respond to escalating climate crises. Moreover, these pressures also influence the reception and interpretation of digital poetry, as in security concerns about Flash leading to the inaccessibility of *Between Page and Screen*.

Even a transdisciplinary practice as tentacular and adaptive as cyborg reading has limits and must guard against falling prey to idealism. To build on O'Sullivan's formulation: we are not all equally cybernetic. Issues of digital literacy, accessibility, connectivity, and so on all weigh against any utopian notions about cyborgs saving the human species from existential crises. The inconstancy of the cyborg milieu is repeated on a micro scale in the present condition of *Between Page and Screen*. What does it mean that the literary space constructed through interaction with this text has collapsed now that readers can no longer augment the printed object? My recordings capture well enough the words springing from each page, if not their movements and animations, but the feeling of getting the glyphs to register with the software cannot be captured in an alternative medium and soon fades from memory. And yet, as we have seen, *Between Page and Screen* does not belong to either reading surface involved, but to a virtual space projected between the two. I can't help but hope that, as the relationships between each layer of hardware, code, and

creative content break down, some aspect of the project persists in a conceptual space augmented by my own personal experiences with the work.

Critical posthumanism steps in here to moderate against the overzealous celebration of digitalism while advocating for flexible and hybridized solutions to our immediate challenges. A particular poem doesn't run in my browser anymore? Cyborg readers view this as another opportunity for discussion, asking what the eventual collapse of the conceptual space of the poem says about the poem. Broken links, incompatibility, and obsolescence are but further avenues into the poem and its persistence in traces, suggesting the value of composite analysis over, say, media-specific analysis or posthumanist theory untempered by an awareness of its limits. The virtue of cyborg reading is that competing views, errors, limitations, and critiques are all permitted and contribute to our understanding of a poem. While it could be argued that this approach is prone to inconsistent results—asking, for instance, if the book component of *Between Page and Screen* is useless now that the AR application is defunct returns both yes and no answers—it could also be said to account for contradiction, multivalence, ambiguity, frustration, and failure in our experiences with digital poetry. Above all, cyborg reading entails a willingness to explore all available options, both in a program's menu and in a poem's meaning.

Transliterary Lifeways

The real-world limits of the cyborg milieu have structured my analysis of each of the digital poems covered in the preceding study, prompting the development of a hybrid mode of reading that takes literary content alongside its materiality and context. I have argued that digital poetry is too broad a field to define categorically, so that only ad hoc definitions of the practice are nimble enough to respond to the specificities of digital poems as transmedial artifacts. These poems may have material and conceptual properties not conventionally considered literary, but which

nonetheless contribute to meaning-making and interpretation. Moreover, digital poetry participates in a highly networked but ever-shifting milieu, linking it for better or worse to the material infrastructure of communications technologies and the systemic issues of widespread digitalism. Thomas terms critical competencies with respect to digital media: transliteracy, or "the ability to read, write, and interact across a range of platforms, tools and media" (101). Cyborg reading is therefore a transdisciplinary critical practice capable of assessing the significance of the various modalities, materials, and milieus we encounter in poetry—digital or otherwise—by applying a composite form of literary analysis responsive to the many concerns involved in meaning-making. In this last section, I conclude by offering a few strategies for developing transliteracy in both creative and critical endeavors, some avenues for future research, and my appreciation for the opportunity to cultivate a transliterary lifeway while pursuing this research.

The new media situation opens upon a new set of skills poetry readers might practice under the auspices of transliteracy. In "Toward a Theory of Canadian Digital Poetics," Spinosa celebrates the "radical potential of digital and transmedial works to engage with *readers* rather than to dwell on the complications of *authors*" (239, emphasis Spinosa's). This position has ramifications for scholars of digital poetry as well as readers, who must navigate the transmedial spaces of literary production and reception to form their analyses. For this reason, Katherine Wooler argues that electronic media "should not be studied in a strictly linear way" (qtd. in Spinosa, "Toward a Theory" 244). To me this means an openness to non-linear strategies for reading not only the poem at hand, but literary work in general. Thus, transliteracy does not discard critical competencies responding to pre-digital media, but adds a host of new competencies to the mix, whereby old skills are brought to bear on new situations while new skills are applied to old situations. The method of applying contemporary critical lenses to the creative work of bygone eras, ahistorical

though it can sometimes be, is a valid form of inquiry that can furnish useful insights—take, for instance, the application of feminist frameworks to the story of Medusa, or of decolonial critique to the plays of Shakespeare—and the same goes for cyborg reading.

Digital humanists have already engaged in academic cross-pollination by bringing digital methodologies into their humanities research, and I reiterate the value of this work with respect to the study of digital poetry. My experience has shown that there are practical barriers to pursuing transdisciplinary studies in an academic setting, even though many degree streams have a breadth requirement and some flexibility built in. Given an increasingly public and participatory culture, we should treat transliteracy skills as foundational rather than ancillary. As Funkhouser puts it:

> [S]uch conditions for textuality, which often blur the boundaries between poetry and prose, or literature and art, have been described by Richard Lanham as "digital equivalency," meaning that, "we can no longer pursue literary study by itself: the other arts will form part of literary study in an essential way." (Perloff, qtd. in Funkhouser 14)

English studies as a discrete discipline faces some provocative challenges as literature becomes more and more deeply entangled in cyborg milieus. In "The English Major as Social Action," Sidonie Smith argues that "[t]echnological change is not just another way of delivering the English major. The digital revolution is having a profound impact on knowledge organization and production and on subjectivity itself. It is bringing with it another way of being a humanities major" (201). Smith identifies networked technologies as the driving force behind the reorganization of the way we process and store information on social, personal, and even neurological levels. Like Hayles, Smith contends that the posthumanist present requires "stag[ing] increasingly sophisticated digital literacies" in our pedagogies and methodologies to support new cognitive modes characterized by "hyperattention (and fragmented reading)" (202).

What might literary studies look like with transdisciplinarity as a foundational principle, rather than as an approach students must justify taking? Smith makes a case for diversity in the technical and analytical skills and models literary scholars employ. Furthermore, the concept of literacy must expand and adapt "to encompass environments joining words, images, moving images, and sound" (Smith 203). Marino presents a slightly different view of cyborg reading practices and transliteracy, which he refers to as cyborg literacy, in the academic context:

> Rita Raley (2002) has speculated about the possibility of computer languages counting for language requirements in undergraduate and graduate programs in the humanities. Alternatively, an interpreter could collaborate with someone who is literate in the language, building networks of literacy, coalitions of meaning-building. (46)

These are good strategies and would help some scholars broaden the scope of their research, though it strikes me that critically-engaged transliteracies are needed in every branch of literary studies, given that digitalism marks us all to some degree.

Some theorists have envisioned a systematic approach to fostering transliteracy. In *Confronting the Challenges of Participatory Culture*, Jenkins identifies a broad set of interrelated skills for navigating the transmedial landscape, including competencies in play, simulation, performance, appropriation, multitasking, distributed cognition, collective intelligence, judgment, transmedia navigation, networking, and negotiation (xiv). Jenkins describes each skill in detail alongside recommendations for educators on how to implement them in classroom settings. These skills, Jenkins notes, are all found to varying degrees in print literacy, so transliteracy is more an extension or augmentation of pre-digital competencies than it is a revolution in the way we understand literary texts (28). Jenkins argues that technical abilities cannot be taught independently of critical reading and research skills, thus, to develop functional transliteracy, its core

competencies should be taught and practiced together. He also suggests that new media proficiencies are social skills, as they involve interacting with the wider cybernetic community. Ultimately, Jenkin's programmatic approach to teaching transliteracy is intended to address the challenges of a new and highly participatory digital culture.

There are critics who feel that programmatic change will be insufficient to adapt literary studies to the digital milieu, and that we need entirely new methods for thinking through transmedial texts. Schaefer advocates for a move away from the orthodoxy of specialists toward a heterodoxy of transdisciplinarity. Likely the most radical literary scholar covered in this study, her ideas are also eminently sensible. For instance, Schaefer would have literary critics avoid an unwieldy menagerie of hybrid formal categories by treating digital poetry as a transmedial network of material and conceptual concerns, allowing critics to produce discourse under the banner of literature without any pretense to disciplinary unity. Her position also supports my observation that specializing in digital poetry actually means developing skills in an assortment of fields and methods, from computer science to experimental poetics, creative practice to criticism. Transmediality encourages cross-pollination and cooperation across fields made artificially discrete through convention. Many critics and practitioners of digital poetry have had to devise alternative ways of existing in the humanities, and, for this reason alone, moving away from specialization toward some sort of professional modularity would, in my opinion, benefit digital humanities, literary criticism, and creative practices alike.

I say all this not to suggest that literary studies as it stands needs to be torn down and rebuilt, rather that it can be expanded upon in tandem with computation. Franco Moretti, for instance, suggests a fusion of literary criticism with computational analysis to study corpora larger

than it is humanly possible to read,[34] and the same principle might be applied to the study of many forms of media. More transdisciplinary opportunities available to more people better reflects the transmedial reality beyond the institution, and if the power of a network is measured not by the number of its nodes, but by the number of connections between those nodes, the power of transdisciplinarity lies in its ability to forge new creative and critical connections in a networked world. As digital poetry accumulates—or, as I have argued, as all literature is increasingly found to bear the hallmarks of digital processes—it becomes necessary to ask: At what point do we consider removing the distinction between digital poetry and poetry proper? Flores suggests that labels like 'digital' and 'electronic' will be cast off as these approaches to literature are normalized, or rather, as we "shake off the rhetoric of linearity that print media promoted" ("Electronic Literature in 2016"). I like this way of looking at things, wherein print media imposes a host of linear restrictions while computers return literature to a state of multidimensional potential.

Romantic notions aside, I have found that digital poetry as a field offers exemplary material on which to model cyborg reading practices. These reading practices reflect the sympoeisis of human cultures and technologies, and embrace a cyberfeminist ethics of care and community working against the problematics of technocapitalism. Skills developed through this composite form of literary analysis—i.e., proficiencies in recognizing and interpreting meaning from a range of media and materials—are of high value in our ever-changing and multivalent media ecology. Transliteracy is also crucial for thinking critically about the impact of a medium on its message, and is therefore of special significance in an increasingly transmedial world. Many of the positions that I have adopted throughout this study align with those of the critics with whom I engage; I see my work as benefiting from and existing alongside their ideas, rather than in contravention of

[34] See Moretti, "The Slaughterhouse of Literature."

them. My hope is that, by putting my personal experiences with technology and poetry into dialogue with the ongoing critical discourse on digital poetry, cyborg reading might be seen, not as a revolution in literary studies or a call to reform the institution, but as a form of critical transliteracy in which contemporary readers are already well versed.

As I tie up the last loose ends of this research project, I look around my office and notice the many chapbooks waiting to be bound, the bag of supplies packed and ready to take to a writer's residency, my hasty notes for a podcast interview, and the mountain of non-academic books in my to-be-read pile. It occurs to me now that these, too, are part of a transdisciplinary practice, that putting aside my scholarly work does not mean the end of cyborg reading and writing. If Smith is right about the cognitive changes we undergo in digital environments, then thinking through and practicing digital transliteracy has changed how I will read, write, and interpret texts going forward. I appreciate that life experiences pay dividends every time we find new ways to use them; I certainly did not suspect as a teenager that the summer courses I took on computer coding and Flash animation would in any way contribute to a study of digital poetry two decades later. I've since learned that becoming an expert or specialist in a field involves policing its borders, and so I'd rather live as an amateur, in the sense Edward Said proposes: "[I]nstead of doing what one is supposed to do one can ask why one does it, who benefits from it, how can it reconnect with a personal project and original thoughts" (83). To me, this means indulging curiosity and inquisitiveness in the search for new forms, functions, or just plain fun. It turns out that embracing transliteracy, like embracing poetry, contributes in countless concrete and surprising ways to an appreciation of the materials of everyday life.

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Appendix 1 – Glossary of Terms

This is a glossary of the terms collected in table 1, Characteristics of Digital Poetry as Proposed under Several Critical Schema (p. 30). Though grouped together in table 1 for illustrative purposes, literary critics use these terms somewhat inconsistently. The following definitions are offered as general glosses on these terms as they relate to digital poetry.

Codework: Creative work written in or incorporating computer code. Though it appropriates machine language, codework may or may not be executable as a program.

Collaborative: Digital tools oftentimes are built and maintained by large communities of people. Texts written using these tools are, in a sense, co-authored.

Computational: Relating to the performance of mathematical calculations, usually by a computer, using pre-defined, formulaic processes. Digitalism relies on computation; however, computation is not necessarily digital.

Executable: A program or file that can be run by a computer. During runtime, the computer reads the code and implements its instructions.

Generative: Capable of producing new content from a given set of source material, often through semi-random recombination.

Hypertextual: The presence of navigable links between elements of a text and various other elements within or external to that text.

Interactive: Accepting and responsive to user input. Invests users with choice and thus a degree of agency over the program's functions.

Multimedial: Involving the use of two or more forms of media in expressive combination. Refers both to the explicit combination of discrete media, as in films with a musical score, and the implicit union of modalities in a particular medium, as words and images are united in text.

Networked: Connected to others in operational interactivity and the exchange of information.

Nonlinear: Movement of or through the objects of a system in a non-sequential manner. Elements of a text may be equally accessible at any time, as opposed to each in their specified order.

Portable: A file or program's ability to be transferred or copied from one device to another. The perfect reproducibility of digital media ensures all copies of a work are identical.

Preservable: Media that can be stored so that it is accessible in the future. This may involve the preservation of hardware along with data and software to ensure that digital assets function as they were originally designed.

Translative: Transference from one language or symbol system into another. Digital texts always involve a degree of translation in that user-facing content is mediated by layers of machine language built atop and out of binary code.

Visual/Kinetic: Graphical representations of language beyond the mere appearance of text. Kinetic refers to movement, though visual work may be static or dynamic.