

Representing Interdisciplinarity in Contemporary Fiction
By Anne Latimer

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Sponsor: Anthony Domestico

Second Reader: Mariel Rodney

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Introduction

I spent the first two years of my four-year literature degree studying biochemistry and mathematics. This was a shift from my earlier plans. In middle school, I wanted to go to college to learn how to write, but I soon became discouraged by grading systems I found unnecessarily abstract and imprecise. Who really gets to decide whether an essay is a B+ or an A-? In my math and science classes, I discovered my academic standing to be directly correlated with how much effort I put into studying; English classes, not so much. Achievement in the humanities can't be quantified in the way that achievement in the sciences can be. In my late teens, I found that ambiguity unappealing, if not oppressive.

So, for two years, I made my bar graphs and wrote my skinny lines of code. The white characters possessed a halogen glow, ghost-like against the black screen of the interface. The methodical, dependable results were comforting: I could predict with a high degree of accuracy what grade I'd receive before I handed assignments in. Zeroes and ones will take you far in this world—I was basically guaranteed a job right out of school—and all I had to do was sit at a desk and stare at a screen eight hours a day for the rest of my life, performing precise, predictable procedures. Lovely.

Students from the humanities would change demeanor when they found out I was a double major in the hard sciences, often describing me as “smart-smart.” Smart-smart, as I understand it, is a term used to describe someone who is competent in technical fields governed by data and calculation. This is somehow assumed to require a higher degree of facilities than proficiency in other fields. The distinction was illogical to me. I'd spent enough hours inputting values into equations and finding bugs in programs that the prospect of reading a poem and presuming to

understand it became a frightening task. I couldn't imagine doing what they did any more than they could in return.

Something was sparking in the back of my mind, though. A wire came undone.

As I got further into my degree, I began forgetting the lessons I'd learned not long before. With each coding language I learned, the previous system quickly became outdated in my brain, the old archives written over with the new. I assisted teaching a calculus class freshman year. I couldn't calculate an integral today.

During my time as a STEM major, the things I'd learned in my high school English courses were still crisp in my mind. I often recalled the big, pink pigs in *Animal Farm*, and the heavy, gray stones in *The Lottery*. My favorite novel that I was made to read in high school was called *A Lesson Before Dying*. It follows an illiterate man on death row for a crime he didn't commit. His mother pays the local school teacher to instruct her son on how to read, write, and speak before his untimely death. It shows that no amount of education, however meager in size or short in duration, is ever wasted.

I switched to a literature major because I began to suspect information is only as valuable as it is able to be retained. The novel, an art form I hadn't touched in years, seemed to possess a supernatural quality surrounding the storage of data and the ability to increase memory recall. Something about entrapping lessons in the web of a story made it stick, but I hadn't the faintest idea what it was. I had the feeling, though, that if I were to parse what made language so good at encoding lessons, I could use it for math and science. Then we could all be smart-smart.

Taking the scenic route to literary scholarship afforded me certain perspectives unavailable to those who had been more focused. This is the application of my roundabout intellectual journey.

I: Sally Rooney's *Beautiful World, Where Are You?* and The Status Quo of the Contemporary Novel

Sally Rooney is one of the most famous anglophone novelists in contemporary literature. Her novels are deeply informed by literary scholarship and often feature leads that are either novelists, literature scholars, or English educators. In this way, her work is emblematic of contemporary fiction more broadly. Writing fiction predominantly featuring characters who are writers themselves leads to books that are, at times, suffocating in their insularity. Alice and Eileen, the two main characters of Sally Rooney's *Beautiful World, Where Are You*, both occupy the precarious position of having careers in the literary sphere as characters in a work of literary fiction. Alice is a novelist, and a famous one at that. She travels to foreign countries to give readings on her books. Eileen is an editor for a literary magazine. Alice and Eileen speak to each other in an epistolary format over email. Due to their jobs, many of their conversations center around the state of their field. Seeing as both characters chose careers in writing, it's telling that neither of them seem to enjoy the contemporary literature they're surrounded by. When Eileen helps out at a poetry reading for work, she makes fun of the poets, who are characterized as self-obsessed and uninspired. Alice has nothing nice to say about the publishing company she works for, nor the other writers she encounters. They're both skeptical that the act of writing is even necessary in order to live a happy life, and believe it may even be an obstruction to doing so. Their interactions highlight the various ways that living and working around mainly other writers limits their understanding of the world around them and their own experiences.

The intentional similarities between Rooney and main character Alice cements *Beautiful World* in the contemporary anglophone tradition of autofictional novels. Autofiction has

numerous, subtly different definitions, mostly centering around ideas of “a genre that deliberately troubles audience expectations regarding fiction and nonfiction for both autobiographical and novelistic ends”(Srikanth 344). In the context of *Beautiful World*, the autofictional elements lie in the similar situation and struggles that author Rooney shares with main character Alice. In an interview with The New York Times, Rooney goes so far as to say this element is what compelled her to write the novel in the first place: “Rooney wrote Alice... as a way of working through a level of attention the author herself found difficult to endure... ‘I think that is why I had to write this book,’ Rooney said” (Christensen). Autofiction as a genre is growing in popularity, with authors such as Rooney, Rachel Cusk, Tao Lin, and many others bringing the originally French phenomenon to Europe and America. This influx of novels about novelists by novelists (and largely for novelists) incites concerns over echochamber-like conditions in modern literature. Rooney, through the autofictional voice of Alice, speaks to many of these anxieties herself.

In one of her letters to Eileen, Alice airs all her grievances with the modern novel and the writers who pen them. This litany is several pages long and acts as a meta commentary for the book itself. Her main criticism is that writing fictional novels constricts the complexities of reality to a harmful extent: “The problem with the contemporary Euro-American novel is that it relies for its structural integrity on suppressing the lived realities of most human beings on earth... the novel works by suppressing the truth of the world” (103). Alice is keenly aware that the extravagant, whimsical lives portrayed in most literary fiction bestsellers are about as realistically achievable to the average person globally as a fantasy novel. This belief that modern authors suppress the realities of all people unlike them comes with a sharp criticism of the tight circles that these writers occupy: “Most of them haven’t so much as glanced up against the real

world in decades... Why do they pretend to be obsessed with death and grief and facism - when really they're obsessed with whether their latest book will be reviewed in the New York Times?" (102). Alice makes two distinct arguments in her email. Firstly, the modern fiction novel is worse than useless, it actively degrades humanity by being so limited in its perspective. Secondly, people who become entrenched in literary scholarship become wildly out of touch, and are unable to function as people independent of their entanglement with their careers. These two criticisms construct a lens through which to evaluate the novel itself as well as the characters' development.

So much of *Beautiful World, Where Are You* is on-the-nose self-commentary. On every other page there's a line like, "You wouldn't believe how long it's taken me to write this paragraph" (146), unsubtly nodding to the various conventional annoyances that come with being a writer. The novel speaks to itself constantly, coming up with reasons why it is or isn't a worthwhile or unique work of fiction when put in contrast with contemporary norms. Alice fears that asking readers to care about the events of her books is morally corrupt, as to absorb a contemporary drama novel is to deliberately turn one's mind away from the collapse of humanity: "we can care once again, as we do in real life, whether people break up or stay together — if, and only if we have successfully forgotten about all the things more important than that, i.e. everything. My own work is, it goes without saying, the worst culprit in this regard" (103). *Beautiful World* is exactly the kind of novel Alice is criticizing here - it's about the trivial folly of people with privileges not afforded to the vast majority of people on earth. It is a respite from the real world, where the stakes are high and the apocalypse is approaching. Rarely does one encounter a novel that plainly asks the reader to close its pages and look up at the real

world. These beliefs about the societal degradation that can arise from overconsumption of fiction are present in problems that the characters themselves face.

At times, both Alice and Eileen struggle to view the world around them as reality and not through the lenses they've learned from analyzing works of fiction. Eileen tries and fails at several points in the novel to shrug away her suspicion that her ex-boyfriend leaving her is a metaphor for her greater failure as a person: "I know that what happened between us was just an event and not a symbol" (45). In her first email, Eileen is adamant that these literary readings of her own life events is something that she is cognizant in the naivety of. However, the thoughts still plague her. Eileen brings up the rejection again later with another friend, still carrying the same suspicions: "I feel like that says something about me on some level. Right? It has to. Frowning, Paula replied: No it doesn't" (68). Eileen doesn't just understand her life through the lens of a fictional character, but she believes that she has been set down a specific path that she has no control over and that will lead her to failure. Trying to talk herself out of it or listen to others doesn't seem to alter her perspective. Alice begins to see new possibilities for herself later on in the novel, not by breaking out of these thought patterns, but by strengthening them "maybe without knowing it, I was anticipating my future, I was watching for signs" (172). That Alice found hope and solace in surrendering to her preconceived notions surrounding symbols and signs is an unexpected argument. Ultimately, the novel doesn't take fault with seeing yourself as the main character of a story, a trait it argues that many members of the modern literary sphere fall into.

Alice's scathing criticisms of contemporary writers being out of touch and inscrutable to the outside world unfortunately fall upon herself as well. Of the few friends Alice mentions, almost all of them are writers themselves, leaving her in a highly insular community. She finds it

difficult to relate to her parents after spending so much time being treated as a highly esteemed author: “I have put between myself and my parents such a gulf of sophistication that it’s impossible for them to touch me now or reach me at all” (196). Alice’s job also puts walls up between herself and Felix, her romantic interest in the novel. Felix works in a warehouse and often finds Alice’s sharp, witty way of speaking arrogant and inscrutable. Alice unintentionally builds barriers between herself and anyone unfit for her highly educated inner circle, showing how academia can often lead to egocentricity that only furthers this cycle.

Of course, the irony of Eileen and Alice’s efforts to break free of this fictional mindset is that they are, in fact, fictional characters. They achieve exactly what they’re meant to do by living interesting lives for readers to enjoy and lust after, thus succeeding by Alice’s definition: “Great novels engage my sympathies and make me desire things” (242). The book criticizes the self-centered, limiting view of the characters’ social circles, but can find no answer to those problems: “Simon said that while of course he did care, in theory, it didn’t seem to make much difference whether he did or not” (273). If one believes that individual attitudes or actions are a drop in the bucket compared to the work that must be done, there’s no reason for any one person to challenge the status quo. The novel has a saccharine happy ending for its lovebird characters and succeeded as a work of art on its own grounds, but its more existential questions remain largely unresolved, or perhaps fundamentally unresolvable.

So much of *Beautiful World, Where Are You* is concerned with what modern writers have wrong. Their circles are pretentious and exclusive, contemporary novels claim to depict reality when in fact they suppress it, and viewing one’s life through a literary lens can be a slippery slope. Rooney is starkly aware of the limitations that come with modern literary fiction’s incomplete perspective. At times, she suggests we do away with the written word entirely. Other

passages seem to indicate that there are benefits to living life like a book character and consuming this brand of indulgent fiction. Rooney gives no final recommendation on how to expand the realm of contemporary fiction, but looking to disciplines outside of literary scholarship is one way to step off the beaten path.

II: Ali Hazelwood's *The Love Hypothesis* and Mad Lib Interdisciplinarity

As much as judging what is basically fanfiction alongside original novels is already a shaky ground for comparison, and as much as *The Love Hypothesis* by Ali Hazelwood never necessarily promised a faithful representation of a career in cancer research, examining its failures to do so actually elucidates the kinds of mistakes that other books of its kind often make. Although the story began as Star Wars fanfiction, it has become a worldwide success. *The Love Hypothesis* has sold over 750,000 copies and is, at the time of writing, featured on main displays in many bookstores. Therefore, it's safe to assume that this novel is at least a few people's first introduction to considering the lives and work of biology researchers. Its main characters, Olive and Adam, are a Ph. D. candidate and a tenured faculty member respectively. Olive wants to create a blood test to detect early stage pancreatic cancer. Adam wants to secure funding for the grad students he advises. Although they both work in the biology labs at Stanford University, they never cross paths until Olive kisses him, a total stranger, out of nowhere in an effort to prove to her best friend that she's completely over her ex. Much of the text is self-indulgent and un beholden to the typical standards of literary fiction, consisting mainly of slice-of-life romance and little plot. The academic setting is secondary to the romantic character studies, but articulating how and why the science-related details of the novel fall flat can open an inquiry on how to do it better.

Most of the STEM-related content of this novel is largely inconsequential in two key ways. Firstly, the sequential events of the novel are, with few exceptions, irrelevant to the STEM setting and characterization. Secondly, *The Love Hypothesis* is mainly a character study, and yet the two lovebird's shared academic background has surprisingly little bearing on their

personalities. Sure, Olive has a perfect GPA and the work ethic to get a Ph. D., but these qualities are unnecessary to propel the arcs of the story and don't come up in conversation in any memorable or meaningful way. In making Olive and Adam's backgrounds in science research inconsequential to their stories, any passage that spends time exploring scientific topics is rendered a waste of the reader's time.

It's worth noting that there's one major exception to this rule. The lynchpin of Adam and Olive's romance is its beginning as a fake relationship. Adam enlists Olive to be his fake girlfriend in order to convince their institution that he's worth funding: "Stanford has decided to freeze my research funds... Optics are that I have not put down roots because I want to be able to flee Stanford at the drop of a hat... If I was in a relationship... that really would help" (45-46). The reasoning is a little shaky, but most setups for fake relationships in fanfiction are even less believable, and at least it brings the reality of funding research into a memorable plot point. The specifics of Adam's grant come into play here in a much deeper way than most other mentions of his work, and its moments like this that make reading the novel's scientific jargon worthwhile.

The Love Hypothesis isn't so much a novel about cancer research as it is about academia in general. Olive often waxes poetic about the epic highs and lows of her graduate program, finding it as irritating as it is rewarding, and criticizing the system while maintaining awareness of her own hypocrisy: "All Ph. D. students were like that: thinking they were better than everyone else just because they had the dubious privilege of slaughtering fruit flies for ninety cents an hour. In the grim, dark hellscape of academia, graduate students were the lowliest of creatures and therefore had to convince themselves that they were the best" (4). It is in this format, a long, meandering laundry list of half-joke qualms, that Olive does most of her ruminating on her career. Importantly, this and many other of her critiques of academia are not

unique to cancer research, or even STEM fields as a whole. Replace “slaughtering fruit flies” with “reading Chaucer” or “editing literary magazine submissions” and the whole rest of the text could easily fit a literature major. This phenomenon, of an interdisciplinary text being interchangeable with any other discipline save for a few details, is something I’d like to call Mad Lib Interdisciplinarity.

This interchangeability applies to major plot points as much as it does to individual passages. The climax of the story occurs when a research advisor at Harvard who offered Olive a grant reveals that he only extended the opportunity because he figured he’d receive sexual favors in return: ““You think I accepted you into my lab because you are good, do you?... A girl like you. Who figured out so early in her academic career that fucking well-known, successful scholars is how to get ahead... You fucked Adam, didn’t you? We both know you’re going to fuck me for the same reason”” (229). At that moment, Olive’s iPhone was still recording an audio file she started for the presentation she gave previously to their conversation, and when Adam hears the tape, he beats the dude up and gets him fired. Again, the details that make this climax possible are not distinct to science research. Men leveraging money and power to procure sexual favors in the workplace is a general workplace problem, not a cancer research problem. The precarity of biology labs offer plenty of opportunities for things to go wrong or right in ways that are just begging for a spotlight here. Anything from a biohazard to a breakthrough could’ve brought Olive and Adam together just as closely without hamfisting a Me Too lesson into a novel that is otherwise disinterested in emotionally taxing subject matter, and it’s a solemnly missed opportunity.

Jargon without substance, a quality inherent to the prognosis of Mad Lib Interdisciplinarity, doesn’t just degrade the value of including those details in the first place, but

also subtracts from the characters' believability as a whole. Critic James Wood points to a similar phenomenon in Ian McEwan's novel *Saturday*, which features a neuroscientist by the name of Perowne as its main character: "Perowne is convincingly rendered in all his literalism and bland scientific ardor; but McEwan overdoes the extent to which his entire life seems to be saturated by medical language and know-how...He watches a drug addict scratching herself and sees... 'an exogenous opioid-induced histamine reaction, common among new users'...Perowne's tendency to supply medical terminology whenever possible violates the delicacy—finely achieved elsewhere in the book—of McEwan's free indirect style, for if Perowne were thinking to himself, why would he need to remind himself so often of what he already knows anyway?" (Wood). In the same way, all of Olive's musings are unbelievable as the genuine narration of a seasoned scientist. She often narrates to the highest degree of complexity she can muster while maintaining a beginner's level of information, a move that maintains accessibility for unacquainted readers but would be unnecessary in her lived reality: "She hadn't forgotten his voice. Or his height. Or the way his stupid clothes fit him. She couldn't have - she had two medical temporal lobes, fully functioning and tucked nicely inside her skull, which meant that she was perfectly able to encode and store memories" (205). Why exactly a cancer researcher would need to recall a high school level of neuroscience to express her passions is unclear. "Medical temporal lobes" is also an offensively redundant phrase. These needless digressions amount to most of *The Love Hypothesis*' interest in STEM, and yet the passages are entirely without cause or value to the narrative.

At first glance, this gripe seems to be at odds with the mission of representing interdisciplinarity as a whole: how can a scientist's inner narrative both avoid overusing jargon and coming off as pedantic while continuing to portray their characterization and actions as

inherently informed by their discipline? The easiest way to answer this question is to look to texts that avoid these problems and evaluate how they do it. *Intuition* by Allegra Goodman, a novel centering on a cast of post-grad cancer researchers, uses perspective to circumvent this conundrum. It is written in close third person, often opening up to a more general omniscient perspective when technical information must be called in, relieving any duty on the part of the characters to “remind themselves of what they already know anyway,” to borrow the words of Wood. *The Bug* by Ellen Ullman, which follows the life of a computer programmer, uses omniscience to its advantage in a similar fashion. The story is told by the main character retrospectively, years after the actual events of the novel take place, and she narrates it as if she were explaining the plot to an unacquainted listener. When she does have to divulge particular details of her craft, she does so in a tone between conversational and educational, as if she were explaining her job to a friend rather than inwardly patting herself on the back for her intelligence.

It’s unfortunate how much notoriety *The Love Hypothesis* gained for all its wasted ink. It actually succeeds as a fluffy, smutty romp (an entirely valid vision to pursue), and yet so much of its runtime is mucked up by irrelevant and anticlimactic academic research babbling. It’s unoften that a subject so omnipresent in a novel as science is in *The Love Hypothesis* is so underutilized and devalued. Olive eventually gets the funding for her cancer screening research, but whether or not it comes to fruition is left out of the narrative, because the content of her research is tertiary at best to the purpose of the novel. It’s understandable that *The Love Hypothesis* didn’t want to spend time tying up these loose ends, but it’s disappointing for a plotline with such potential to be picked up just to be dropped. The real problem with this novel is that it’s unfocused on its central conceit, and in the process, does some undue damage to the public perception of what it means to pursue a career in cancer research. Thankfully, other texts offer hope. Using omniscient

perspective to more seamlessly integrate the trappings of a scientific narrator is only one of the many ways *Intuition* and *The Bug* beat out *The Love Hypothesis* as novels representing interdisciplinarity. Ridicule has its uses, but picking out how *not* to write interdiscipline in fiction is an incomplete effort. Doing it justice requires looking for insight in greater novels.

III: How Ellen Ullman Translates Between Diverging Disciplines

Ellen Ullman is an American author specializing in memoirs and novels that address the ways in which a better grasp on the humanities can benefit the hard sciences and vice versa. She's written two memoirs, *Life in Code* and *Close to the Machine*. The attitudes and cultural narratives in the field of software engineering showcased in her memoirs deeply inform her tragedy fiction novel *The Bug*. Ullman's memoir collection spans her career as a programmer from the seventies to the present day in a male dominated work culture. Her observations center mainly around persisting problems of communication, translation, and philosophy in the worlds of the internet, artificial intelligence, and information systems management. Interestingly, the most cutting edge, pertinent projects of the programming sector continuously circle back to the most basic problems addressed by the humanities. What does it mean to be human? How do we create systems that best serve and care for those who must live under them? Ullman uses her narration and communication skills learned from her work in the humanities to solve the most difficult tasks she encounters in her career as a coder, indicating that a more holistic view of engineering may most benefit the greatest problems facing the field today. Formal aspects of coding, such as the nonlinear, compartmentalized, and iterative nature of the programs worked on in *The Bug* end up informing its narrative structure. Ullman's interdisciplinarity illuminates the specific ways these two branches of academia can and should mix.

Ullman defines the use of technology as inherently incommunicable before positioning herself as a translator of these untranslatable concepts. One passage about the early internet describes two women being unable to verbalize their web browsing experiences to one another after trying the World Wide Web for the first time: "What had happened to them, each in her own

electronic world, resisted description... the two women fell into verbal confusion. How could they speak coherently about a world full of little wordless pictograms, about trails that lead off in all directions, of idle visits to virtual places chosen on a whim-click?" (Life in Code 82). This lack of vocabulary is concerning. Inability to give feedback, make criticisms, or start conversations can't be conducive to programmers trying to improve the web, nor to the new users trying to acquaint themselves in this world. This inarticulability is not helped by the simultaneously insular and isolating culture of software development. At a myriad of points throughout the memoirs, her coworkers' inability to talk or convene like well-adjusted adults ends up complicating her work. Ullman recounts: "I once designed a graphical interface with a man who wouldn't speak to me... "I can't do it by talking." ... "So how can you do it?" I asked. 'Mail,' he said immediately, "send me email'... Corporations across North America and Europe are still using a system designed by three people who sent email, one of whom barely spoke at all" (Life in Code 15). It's difficult to build a vocabulary with which to describe the work of people who cannot speak. The problem of describing the life and work of a coder is not so much an innate quality of the field but a lack of people trying to do so. Ullman understands her life's work as a response to this deficit: "The role they assigned to me, translator, is perhaps the most accurate description of everything I have done concerning technology" (Life in Code 242). The work of this translation is inextricable with her training in the humanities.

In her memoirs, Ullman highlights a tension between software engineers' simultaneous distaste for and reliance on the humanities, particularly sociology and philosophy. After Ullman fosters a budding interest in symmetrical multiprocessing, a kind of system that links multiple processors to the same source of memory, she finds it embarrassing to share the reasons for her intrigue: "The problem seemed to combine mathematical theory, the physicality of performance

on actual machines, and philosophical questions about how one discerns precedence, what should go first. Any serious software engineer would scoff at my dragging in philosophy, the fuzz of the humanities” (Life in Code 101). As in this example, Ullman’s most obsessive niches in her coding career continuously go hand in hand with greater, farther-reaching questions of exploration and creativity. When she was first learning to code, Ullman learned a language that jumped back and forth spatially in accordance with which chunk of code was being run. The process reminded her of the education she received while writing her thesis on *Macbeth*: “I told myself if I could follow the flows of time in *Macbeth* - where the past kept being mistaken for the future, as perceived time rolled backwards and forwards, with a singular starting moment in the present, when Macbeth kills the king - well, these code tangles were nothing” (Life in Code 241). By understanding the different sections of code as a non-linear narrative, her task shifted from a disconnected mess of classes and objects and into a traceable, manageable process. These qualities apply to the internet as much as they apply to the code that creates them as well. Ullman describes the winding nature of web surfing with the language borrowed from the tradition of Gothic novels: “They click ‘Back’ then ‘Back’ again, and, like players in a Victorian maze retracing their steps, they emerge to find they are only at the place where they entered” (Close to the Machine 77). This framing, translated into the language of the novel, sets up the timeline for *The Bug*.

The zig-zagging nonlinearity of most computer programs is reflected in the temporality of *The Bug* in an extrapolation on the concepts brought forward by Ullman’s memoirs. The novel begins at the end, with narrator Berta interrupting her pleasant retirement from a long and lucrative career in programming to ponder her long-dead coworker Ethan: “Time circled back on itself. Nineteen eighty-four” (The Bug 7). The choice to set the main events of a novel about

technology's tyranny over humanity in 1984 is a little on the nose, but the theme of jumping through time spirals out from then on. Ethan tags his code with the phrase "Here you are, Ethan" in a pathetically endearing gesture of self-soothing that transcends time and space: "Over the years, he'd come to understand the message as a kind of rope line he was tossing to himself, a thought sent from the present day's Ethan to the Ethan of the future... 'Here you are' to 'Here you are,' the moments Ethan spent working on his simulated world came together as they always did: sequential points along a solid line, the arc of a separate, private, parallel, unfinished life' (The Bug 34). Each time Ethan opens his code, he's immediately reminded of every other time he's read the phrase, often pausing to recount these past moments with progressively more mature and complex perspectives. Upon reading his own messages, Ethan often slips into a dreamlike state where memories float through his mind and he loses his sense of self, such as remembering fleeting details of a mentor from long in his past: "Here. Here. No, here. Where was he? Where was the Ethan who had left the message?... He thought of Harry Minor... Harry. Gone. He never really expected to hear from Harry again" (The Bug 315). Ethan is already dead at the beginning of *The Bug*, and much of his time in the novel is spent jumping rapidly between the true present, the year leading up to Ethan's death, and his memories from his earlier life. This abrupt, compartmentalized, non-sequential temporality reflects the way a computer program runs, marrying the structure of the novel with the structure of the code that propels its plot.

The Bug features numerous scenes that iterate repeatedly, differing only partially in each instance, a formal aspect that mirrors the way a program can transform a variety of different inputs with the same processes. Code that can perform the same task on different inputs are integral to most complex programs, such as the project that the coders in the novel interact with at work: "Get input, determine what it means, do something in response to that meaning, then

wait for input again” (The Bug 333). This basic idea, that putting different information into the same system will result in related outputs, haunts the narrative on several fronts. From the beginning of the novel, Berta is aware of her partner James’ cheating nature. She recounts a memory of waking up to James’ other girlfriend pounding on their door and screaming at the top of her lungs after learning about his infidelity. Berta finds the woman’s meltdown messy and embarrassing. She ends the passage pondering whether the same fate awaits her: “Could that be me someday? Of course it could... I’ve learned there’s a good chance you’ll end up like the person who came before you. People tend to repeat these sorts of things, in my experience” (The Bug 15). When Berta inevitably finds out that James is cheating on her, she has a similar reaction: “Then I exploded. Ugly, cursing, shitty things - like anyone would say in my place” (The Bug 275). By inhabiting the other woman’s perspective, Berta learns that no matter who the input is, certain outputs are always the same. Berta initially found the first woman’s tears and screams unfathomable, but in her position, she surrenders to the same emotions. This iterative process also describes how Ethan’s relationship to his father ends up getting reproduced between Berta and Ethan. When Ethan’s father dies, an event likely tied to his rampant alcoholism and self-destruction, it ends up pulling Ethan out of his PhD program on theoretical computer science and propelling him into a career of information management engineering. Ethan himself eventually succumbs to alcoholism and commits suicide, an act that leads Berta to take on his previous career. She describes the time after his death as “a suddenly opened door that introduced me to the real pleasures of the programming life” (The Bug 331). These instances of variations on a theme are a novelistic translation of basic coding processes. By using logic borrowed from computer science, Ullman foreshadows her characters’ developments, connecting them by how they act similarly or differently in the same situations.

Ullman's memoir *Close to the Machine* aims to define the state described in its title, a mindset that consumes *The Bug's* main character Ethan and eventually leads to his downfall. Being "close to the machine" is an intense dichotomy of fantasy and unrelentingly literal, mechanical reality. It is about simultaneously succumbing to dreams of progressing technology, and being keenly aware that these goals are within reach if only one can type the correct series of symbols into a programming interface. Whether a programmer dreams of cyborgs or hacking the stock market, the line between the real and unreal is only a deft click away. The language of code resists this level of vagueness. Computers can't reason, assume, or fantasize, but technology nonetheless represents the cutting edge of our projected futurity. Getting close to the machine goes hand in hand with subjugating the disorder of the human mind, causing it to leak out elsewhere: "The programmer, who needs clarity, must talk all day to a machine that demands declarations, hunkers down into a low-grade annoyance. It is here that the stereotype of the programmer, sitting in a dim room, growling behind Coke cans has its origins... The messiness cannot go into the program, it piles up around the programmer" (*Close to the Machine* 23). Getting close to the machine requires the basis of religious psychosis and the trappings of science fiction. Joan of Arc meets *The Jetsons*. Ullman describes a coworker getting closer to the machine as a loss of humanity in favor of the unbounded creation available through code: "He becomes electric, turns to the keyboard and begins to type at a rapid speed. Now he is gone from me. He is disappearing into code - now that he knows it will work, now that I have reassured him that, in our universe, the one we created together, space can indeed be forever and reliably numeric" (*Close to the Machine* 4). The concept of being close to the machine is a common phrase in Ullman's vocabulary and informs her characterization of Ethan.

Ethan's mental decline coincides with getting closer to the machine. When he's not mindlessly fixing bugs at work, he spends his limited free time trying to code intelligent life. Ethan's mistake is that he tries to create life by becoming completely disconnected from his own humanity. His code seeks to recreate the complexity of life by breaking it into its smallest composite parts. His program works by spawning little characters representing organisms that can do little more than eat, reproduce, and die. This view of life's core as mindless, simple mechanisms breaks down his understanding of himself: "No boundaries, the whole world just one big bag of vibrating molecules. Like Ethan Levin: nothing but a bag of proteins imagining himself. Inside: nothing. A zombie process, a trick: a trick of the code" (The Bug 320). Ethan then commits suicide by hanging himself with a computer cord, a physical manifestation of the way his obsession with technology has consumed him: "Get that perfect white cord. Untie it, release it, free it. Get a chair. Throw it down the stairs if you have to. Go to hell. Goto. Ha! Unconditional. Jump" (The Bug 323). Ethan kills himself, terminates his own program, because his effort to create artificial life is insufficient and meaningless. Ullman's memoirs further expand upon these issues surrounding artificial intelligence and the ways that those who are too close to the machine can lose sight of the truth at the heart of life.

The field of artificial intelligence development inevitably runs up against philosophical questions about what it means to be alive, intelligent, or human. Ullman finds that the kind of intelligence that developers try to create is distinctly cleansed of anything dirty or messy, like anger, irrationality, or bodily functions. She finds that these programmers resist interrogating the ideologies they hold about human deficiency. She criticizes these widely held notions that are omnipresent in the artificially intelligent robotics sphere: "Here is the underlying motive of robotics: an anti-intellectualism in search of the intellect, a flight from introspection, the desire to

banish the horrid muddle of all this ‘thinking about it,’ thousands of years of philosophical speculation about what animates us, without notable progress” (Life in Code 145). One of the ways that robotics engineers dodge these questions about individual humanity is to instead look to other, more impersonal concepts of intelligence in nature, such as the ant colony. In a passage about using ant colonies as a model for artificial intelligence, she states: “As a research model they provide an enormous advantage over the study of human brains: they yield an explanation of how apparent complexity can arise without an overseeing designer. A group of dumb ants produces the complexity of the ant colony - an example of organizational intelligence without recourse to the perennial difficulties of God or philosophy” (Life in Code 140). Certain kinds of “artificially intelligent” programs are modeled after this conception of the colony. Ullman states that once these ant colony-like systems begin running on their own, they quickly exceed the control of the programmers that set them into motion: “The complexity of the environment tends to move beyond the easy comprehension of an individual programmer” (Life in Code 143). In short, those who created the code lose the ability to read what it has become. This circular problem of trying to create something self-sufficient and self-improving only to watch it eat itself alive is nearly analogous to this entire notion of solipsism in the programming community. By only looking inwards, the question of artificial intelligence goes continually unanswered.

Ethan may not have found the key to the difference between man and machine, but Ullman has an answer of her own. Ullman centers the ability to “read” both literally and metaphorically as the pillar of humanity that code will never be able to express. She defines her argument in the context of mammalian processes: “Mammalian life is social and relational... What makes mammals different... is the possession of... the limbic system. And it is the limbic system that allows us to do what other animals cannot: read the interior state of others of our

kind” (Life in Code 151). Recognition of the other is integral to the survival of mammals, a trait that eludes artificial intelligence motivated entirely by rationality and self-sufficiency. There would be no point in “reading” another member of your kind from the perspective of an intelligence created with unambiguous, completely predictable mechanisms. Code as a language resists vagueness and nuance. You can’t say one thing and mean another in a line of code. This mammalian reliance on intuition, sensitivity, and translation is what eludes programs, and in Ullman’s eyes, makes true intelligence an artificially unreplicable status.

The titular bug that Ethan cannot fix fittingly examines the increasingly hazy line between human and machine. While Ethan works on artificial intelligence at home, he’s unable to parse an error in the program he works on at his day job, a bug that periodically crashes the program when the user drags their mouse off a menu on the screen. The bug, which seems innocuous, slowly escapes the capture of every programmer put to the task and earns itself a sinister reputation: ““A little jester of a bug’ Harry Minor called it at their last group meeting. But Harry’s joke, meant to be reassuring, had the opposite effect. The bug had acquired a personality, a character, a will. And a name: *Jester*” (The Bug 142). Berta finds the cause of the bug after Ethan’s death, and its origins are startlingly human: “It was all suddenly clear. Sampling. Of course the mouse worked by sampling.... Time, motion through time - the thing we call analog, continuous, flowing, infinitely variable - had to be interrupted by the digital, on-off workings of the machine” (The Bug 346). The mouse controlled by the human only samples its position and sends that information to the program to be processed periodically. The elusive nature of the bug can be chalked up to the mouses’ variable fallibility. *The Bug* is set in a time period where the mouse was a relatively new piece of technology, where programs were only starting to catch up with the demands inherent in more complex inputs from human use of

the interface. Ethan's closeness to the machine led to the embodied nature of this bug completely escaping his scope of comprehension. Ethan's eventual obsession with his artificial intelligence project arises as a method of coping with his insecurity of being an incompetent engineer at work. Were Ethan more concerned with the humans that used his program than the technical parameters of his code, he might have succeeded in fixing the bug, ultimately making it out alive.

Code is a language, and Ullman expertly unravels its narratives, linguistic progressions, and shortcomings. She uses Shakespearean temporality to make sense of tangled programming, then uses the temporality of programming to write complex stories. Through the project of artificial intelligence, she returns to sociological arguments to define what it means to be human. She understands that technology is created to benefit humanity, a near maternal act of care, and that one must be aware of its place in the greater context of the anthropocene. Her memoirs show the ways storytelling and philosophy are indispensable tools in a programmer's repertoire. Her novel exemplifies how the logic of programs can be used to foreshadow, characterize, and create tension in the realm of fiction. Ullman knows that further progression of technology and stories alike is dependent upon better ideologies and avenues of communication, and provides the steps needed to reach a more well-rounded future.

IV: Procedure as Narrative in Allegra Goodman's *Intuition*

Intuition by Allegra Goodman begins as a story about a breakthrough discovery in cancer research, becomes a mystery novel, and finishes as a meditation on how progress in the field of science is beholden to emotion and language to a startling degree. The story follows Cliff and Robin, two postdoc researchers working in a biology lab in the 80s. Cliff wants to develop a synthetic variant of a virus called RSV as a potential cancer treatment. His experiment provides incredible results, reducing tumors in mice at a nearly unbelievable rate. Goodman's prose renders these research processes with delicate command, using literary devices near antithetical to the tradition of the novel. Robin is suspicious of Cliff's published findings and levels criticisms against his methodology. The lab supports Cliff, and each side scrambles for clues to support their beliefs. Very quickly, things spin out of control, as bad actors from news networks and the judicial system quickly capitalize on this sensationalized story as an opportunity to fuel their own careers. How and why Robin's sound criticisms become untethered from her control has to do with how lessons from the humanities, such as storytelling, are integral to individuals looking to excel in the sciences.

The several arcs of *Intuition*'s plot shed light on Goodman's many strengths as a novelist, and the first section detailing the day to day lives of the researchers gives particular attention to her imaginative yet precise style of prose. The complex processes constituting the researchers' average work day are described in a fashion both curious and familiar, evoking both wonder and comfort: "Two to a bench, like cooks crammed in a restaurant kitchen, the postdocs were extracting DNA in solution, examining cells, washing cells with chemicals, bursting cells open, changing cells forever by inserting new genetic materials... Glass beakers stood above on

shelves, each beaker filled with red medium for growing cells. The glass beakers were foil topped, like milk bottles sealed for home delivery” (1). Likening the researchers to cooks and the cell media to milk bottles paints the pristine lab as a cozy space. It is in this wording, that neither talks down to the reader nor lectures them, that the sensitive and specific content of their research is described. The details of Cliff’s work with the virus, though worded clearly in the text, “For years he’d been developing a variant of Respiratory Syncytial Virus and had dreamed of using his modified RSV to transform cancer cells into normal cells” (5), could’ve easily been delivered in a far more overcomplicated way, thus detracting from the grace and ease of the plot. Understanding how to introduce information about science research without coming off as cold or superior is integral to the effectiveness of *Intuition*.

Goodman’s way of grounding these complex scientific tools and processes stands in direct opposition to Shklovsky’s definition of the purpose of art. In his seminal critical text, *Art, as Device*, Shklovsky argues that “The goal of art is to give the sensation of things as seen, not known; the device of art is to make things "unfamiliar," to increase the difficulty and length of their perception, since the perceptual process in art is valuable in itself and must be prolonged; art is a way of experiencing the artfulness of an object, the object in art being itself unimportant” (Crawford 210). This is to say that Sklovsky believed art must take that which is known and make it strange, to draw out the time spent decoding common subjects until they become alien. He called this idea defamiliarization. Goodman does the exact opposite: she takes unfamiliar, complex subjects most often dissected in longform, and makes them friendly and simple. She familiarizes the unfamiliar. Familiarization both grounds *Intuition* as a challenge to the novelistic tradition and acts as a vehicle for employing copious scientific subject matter without being boring or illegible, but rather comforting and encouraging.

Much of the first third of the book is constituted by the minute steps of Cliff's research, from measuring the mice's tumors to sacrificing and dissecting them. The cyclical, methodical steps of the scientific method carry on the narrative, graceful in its predictability. Using specific viruses to either directly attack cancer cells or encourage the immune system to do so is far from unheard of. What makes Cliff's virus so unique is, initially, its apparent rate of success. After injecting his virus into mice with tumors, a startling number of them go into remission. His findings are published and receive a massive amount of attention. Robin becomes more suspicious of his results over time. She's tasked with trying to recreate his findings in a second trial, and fails. When one of her coworkers hears of this discrepancy in results, he comments, "His results seem almost too good to be true" (144). Robin trying to reproduce Cliff's results is an example of what happens after a scientific publication of note takes place, continuing the narrative's interest in science research past the easier structure of a clear, unchallenged breakthrough. If Robin were able to reproduce his findings, his claim would increase in reliability. Her failure to do so gives Robin a hunch that Cliff's research was either methodologically unsound or otherwise fabricated. The novel turns from a story of discovery to a possible mystery when Robin happens upon notes that seem to indicate Cliff killed off mice whose data points did not support his preconceived hypothesis.

The moment that Robin levels suspicion against Cliff transforms *Intuition* from a hero's journey to mystery. Suddenly, questions over Cliff's culpability, and the need for further clues to validate his mismanagement consume the dissenting voices, from Robin to her legal team to the skeptical members of the public. To spoil the ending, it's never clear whether or not Cliff tampered with the results. This ambiguity is largely antithetical to the goal of a generic mystery novel, "a story whose meaning readers passively digest" (Rolls 179), due to the nature of the

ending. By finishing with a definitive culprit, the typical mystery novel “engages in its own self-interpretation” (Rolls 178), or in other words, dismisses all other possible endings in a way that makes the red herrings obsolete. Critic Alistair Rolls argues that ending-focused readings of mystery novels, wherein the reader assumes all other suspects’ backstories are not worth actively parsing during the reading due to an eventual definite end, is an incorrect way to experience a mystery novel. By leaving it unclear whether or not Cliff willfully committed fraud, and as a separate matter, whether or not the data was compromised by some other force, *Intuition* avoids falling into the pitfalls of the mystery novel without the extra mental gymnastics. This encourages readers to collect the sparse data the text provides, and continually ask themselves what the true answer may be. To encourage this level of inquiry within the reader is fitting for a science research novel, a discipline whose primary concern is the collection of data in order to come to the most logical conclusion. The ending puts readers in the role of the scientist, with the novel as the subject. Furthermore, *Intuition* still provides a largely satisfying ending despite its lack of a clear villain because it’s varied enough that the plot of Cliff’s research is only one of the many quandaries facing the characters. Not only does *Intuition* implicitly call upon readers to think like a scientist; its ability to reap the benefits of employing a mystery plot while sidestepping its shortcomings is similarly deeply sophisticated.

When Robin tries to address her concerns with the lab’s higher-ups and her fellow researchers, she encounters a number of frustrating disconnects between communication, performance, and impersonality in her field. Robin presents her evidence with by-the-books language and pacing. She uses clear graphs showing the discrepancies between the published results and Cliff’s notes and restates her data plainly: “The first graph displays the published results... As you can see, the published results cluster beautifully... When we take the published

and unpublished results together, we find only thirty percent of the animals are cancer free, and almost seventy percent still have cancer after treatment” (202). Her delivery is a little boring, to be uncharitable, but it’s par for the course. Cliff’s rebuttal, on the other hand, evokes positive emotions and uses an easily followed, intuitive narrative. One might expect that such unscientific methods would fall flat to a panel of researchers, and yet the opposite is true:

One by one he took on Robin’s assertions and, it seemed to her, sidestepped each in turn... As he showed his lab book and interpreted the numbers there, his voice was lively, his enthusiasm infectious. The torturous connections Robin had attempted gave way to a scientific argument so natural, so compelling and intuitive that everyone in the room seemed to relax... She had spoken well, but Cliff spoke better. He had the more compelling argument, because his results were beautiful. Hers were more negative, her argument distasteful. He worked in the bright, empirical realm, and she had mucked about with dark, dubious, moral forebodings. Perhaps Cliff’s record keeping had been poor, but his achievement was tangible; his mice had been sick and now they were well. Even as he spoke about his work, Robin felt the mood shift. With a flick of the wrist, the meeting became a research seminar... How delighted they were to return to science.

(202)

Cliff makes a particularly sensitive argument in his response. He is not using the scientific method like Robin does, but he tells a story that fraudulently considers itself scientific to get the room on his side. Robin lost her credibility to Cliff not because her points were worse, but because her argument lacked emotion and her narrative structure was less compelling. For all the

heads of the lab like to believe that intuition is secondary to evidence, “On the ground, in the lab, intuition was a restricted substance. Like imagination and emotion, intuition mislead researchers, leading to willful interpretations” (183), the reality is far more complicated.

While Cliff enjoys renewed allegiance from his coworkers through the use of good storytelling, Robin feels the consequences of the scientists’ spite. Robin feels her coworkers’ training turned against her, as she becomes the object of scrutiny: “She knew exactly what the others thought, and it hurt to be treated like a hazardous material, to be isolated and manipulated with gloved hands” (187). Robin takes on the role of the lab rat, serving only as a means to a data point, a source by which to gain a satisfying conclusion. However the lab workers feel about Robin’s testimony, they’re far from the only onlookers. Her story gets picked up by the press through a journalist named Jeff, and the plot thickens.

As the lab’s quarrel over Cliff’s research falls into the public eye, an unlikely source ends up aiding the postdocs as they navigate uncharted waters. One of the lab’s managers, Glass, has a daughter named Kate pursuing a career in literary criticism. Kate’s specialty ends up aiding the lab when journalists negatively portray them in the press. She understands the article not as a personal attack, but as a side effect of the industry ““It’s not really about you, anyway,” she said philosophically. ‘Who else could this article be about?’ ‘It’s about Jeff,’ said Kate. ‘It’s about how he wants to be editor of the newspaper. It’s him showing off, not you’” (163). This change in perspective ends up percolating through the rest of the lab workers, and ends up impacting how they navigate the press and court later in the story. Kate’s literary training benefits the lab, bringing them indispensable perspective in a time of strife.

Although the media frenzy percolates into a convoluted and ultimately unproductive court case, the charges are overturned and Cliff is absolved of any guilt. “He was free, no longer

encumbered with accusations...Free of blame, and free of Robin... Now Robin saw that her work had been in vain. Despite ORIS, and despite the failure to reproduce Cliff's work in other labs, he'd won" (328-329). He was not a good scientist, but maybe he was never trying to be: "Perhaps his work with R-7 had been more about ideas than concrete facts; perhaps his findings had been intuitive rather than empirical" (321). All Cliff wanted was to tell a great story. He got to be the main character of his very own hero's journey, and although he may get to live that out in his own life, the story of *Intuition* has other plans.

While all of this is going on, the central question of the novel quietly unfolds behind the scenes in a way most befitting to a narrative of scientific research. Some of Cliff's remaining living mice from the original experiment have re-developed the cancerous tumors that his virus initially healed. "There were...recurrences. Ordinarily, she would've looked into a phenomenon like this with intense curiosity and undiluted pleasure. But now? Why now?" (307). Of course, to investigate and publish findings on these recurring tumors would be to undermine Cliff's initial paper, thus undoing all the work the lab just did to clear his name. The details of Cliff's mice, whether he really did tamper with his data, and why they eventually re-developed cancer, is left a mystery. Most scientific papers dedicate a portion of their concluding section to listing several areas of interest related to the experiment's central focus that deserve more research. Doing so both grounds the singular paper in an ongoing dialogue of broader research and also provides reasons to ask for more money from donors. Ending on an open question employs a novelistic narrative structure that mirrors the format of a scientific paper, illustrating *Intuition's* interest in the field of science research in a deep, sustained fashion.

Cliff's faults lie in the unreliability of his account, but he's actually a phenomenal case study in the benefits of effective storytelling in scientific application. Cliff isn't necessarily more

persuasive than Robin simply because he can tell a story, but because of the specific narrative tools and details he employs to make his arguments particularly compelling. Even before Cliff is defending his work against criticism, he refers to it with language that is unique for the circumstance: “Over and over he looked, and each time he made the discovery again: his virus had worked on cancer cells. He had never seen anything more beautiful or more important than that mouse before him on the table” (69). To call the data of research results, even of this magnitude, “beautiful” in a lab setting is more than a little unconventional. It is with this language that Cliff repeatedly showcases his findings, especially in the presence of an audience, such as the passage from his debate with Robin: “He had the more compelling argument, because his results were beautiful” (202). It helps that Cliff had the material of a spectacular tale, but his affectation helps too. Later, his coworker Aidan describes the event with the gravitas of a presidential speech: “There were only seven people in the room, but, as Aidan said later, Cliff might have been on stage in front of thousands; he had such presence. Cliff spoke with total mastery” (78). Public speaking skills and subject matter aside, he examines his own vocabulary with the magnitude of a microscope. Cliff finds the language with which he refers to his results to be about as important as the results themselves: “He... debated the language he would use. Treatment with R-7 yields stunning results. No. Striking results. He could not stop considering and reconsidering” (73). This self-editing behavior is far more characteristic of poets than scientists. Cliff doesn’t just want to relay his data, he wants to stun, to strike, and this particularity is what convinces his coworkers and eventually the public to rally behind his cause.

It also helps that Cliff is keenly aware of the cliches he falls into as an individual and uses them to his advantage. He possesses a carefully constructed and entirely self-aware outward character. He’s well-educated, even among his post-doc colleagues. Robin, many years his

senior, feels this gap in prestige: “Robin’s thesis advisor, John Uppington, was well respected, but Cliff’s had been renowned, and his graduate work that much more lustrous” (63). With this background, it’s easy for Cliff to slip into the identity of the nonchalant genius. Characteristics that would be unbecoming on the other researchers are forgivable quirks on him: “while his hair and beard badly needed trimming, he seemed dashing in his scruffiness — devil-may-care and pirate-like” (61). It is with this mildly self-effacing mischievousness that Cliff makes his defense against Robin’s criticisms: “He confessed he had been careless... Then he opened up his lab book on the table, and there the dates and data matched up precisely...his voice was lively, his enthusiasm infectious... Cliff was so intelligent, so winning - he would be a star. And why did she mind so much that he was messy going about it? Many, many researchers were”(203). By embodying the cliché of the precocious scholar who coasts on charm and natural talent, he absolves himself of critique. Even if he had tampered with the results, which is left unclear, admitting it to himself would mean the destruction of his facade. He affects this lackadaisical but brilliant personality — infuriating in his effortless, suave intellect. He’s not much of a hard worker, but whenever he does work hard, he sure makes it look easy. Persona is a powerful tool in persuasion, and Cliff’s command over the perception of his character is an ability taken from storytelling that he skillfully leverages against rigid, scientific logic.

Intuition argues that creating a masterful novel about a STEM discipline, much like being an actual researcher, necessitates both knowledge of the scientific method and the communication skills to narrate findings in an engaging way. Robin was correct in her suspicions against Cliff, and yet her inability to present her concerns or tactfully grapple with the journalists and court officials overseeing her case ends up largely absolving Cliff of any wrongdoing. Cliff, as a competent storyteller, writes his own tale. Goodman shows us the bigger picture,

intertwining the suspense and twists of a good mystery novel with the structure of a scientific paper. The ending speaks elegantly both to the history of the mystery plot while simultaneously encouraging readers to use an interdisciplinary lens. The gentle prose reconsiders the validity of Shklovsky's beliefs surrounding defamiliarization, which are often taken as fact. None of this interaction with the literary tradition compromises on the novel's engagement with the sciences. The process of Cliff's research is pleasantly believable, as is his characterization. The problem with Cliff is not that he's a phenomenal public speaker with undeniable boyish charm and a penchant for spinning criticisms into opportunities for fortifying his own character — it's that he possesses all of these skills and lacks the truth and substance to back it up. Convincing people you're a capable, brilliant researcher is a separate skill to actually being one; mastering each is necessary to being an effective scientist in the contemporary world.

V: The Value of Narrative in Real-Life Science Communication

The majority of this paper argues for the value of using atypical narrative structures from the hard sciences in literature, but the opposite is equally true. Science research articles almost ubiquitously follow a format that is unique to all other types of textual publications. In the name of reducing potential bias or misinterpretation, science articles are often drained of all potential excitement and engagement. Papers from the hard sciences often try to be vehicles for data and methodology, only calling upon other papers or outside information insofar as it benefits the central goal. This relative absence of context is something Berkeley biology professor Kevin Padian calls “anti-narrative,” a phenomenon he finds to be at odds with communication and education: “The structure of scientific explanation seen in peer-reviewed papers and grant proposals obscures true narrative within a formulaic sequence of producing an ‘anti-narrative’ that must be ‘un-learned’ before it can be communicated to non-scientists” (1). Science communicators, such as author Faith Kearns, find careers for themselves in closing this communicative gap caused by anti-narratives. In her book *Getting to the Heart of Science Communication*, she outlines the difficulties and philosophical questions posed by her career as a “practitioner” of science. She works in a field that acknowledges that “disciplinary knowledge is important, but it isn’t enough” (75). Dissecting her methods of communication shows how storytelling can aid in bridging the gaps the divides between disciplines.

Science communication, also referred to as scientific outreach or engagement, is an example of how a new discipline can emerge in response to needs that no existing discipline can satisfy. While the actual content addressed by science communicators centers on the transformation and dissemination of information from the hard sciences, like ecology, medicine,

and meteorology, the actual content of their jobs is often borrowed from the humanities. Acting exercises, art exhibits, and active listening lenses that arise from theater, art history, and literary studies respectively: all of these aid the science communicators showcased throughout the book. Exploring how, and why, these avenues of education and exploration facilitates science communication shines light on how learning and changing perspectives requires more than the cold hard facts.

People graduating with hard science degrees now end up on career paths that require training in communication and community outreach in startling numbers. In other words, it's growing in likelihood that STEM graduates will quickly encounter jobs that expect aptitude in skills that they did not develop as a part of their degree. Science degree requirements are often irrelevant outside of academic research, and yet, "50 percent of doctoral holders in science, engineering, and health are employed in professions other than academia within ten years of graduation" (29). The answer to this disconnect is more complicated than just adding a communications requirement to every science degree.

After making the most obvious proposal—namely, that science researchers should receive better training in communications as a step on the path to their degrees or certifications—Kearns pulls back to gesture towards a different approach. She includes a quote from Gannet Hallar, an atmospheric scientist who acknowledges her deficit in communications and supplements her projects by simply working alongside communicators: "There should also be a way forward for people like me, whose real strength is in research, to collaborate with people who are good at communication" (32). This method reinforces the argument that science communicators actually occupy a discipline distinct from science researchers, and that mutually beneficial coexistence between the two may be more helpful than calling for overlap.

One of the hurdles making this kind of collaboration difficult can be seen in the reductive requirements that are deeply entrenched in academic settings: “The academic reward system does not yet lend itself to practitioner partnerships in a way that honors what practitioners bring to the table” (43). Due to these limitations, a paradox arises out of the delicate forces turning current scholars towards or away from communicative careers in science. Although 50% of the job market demands pedagogical, writing, and communication skills, most of those employment opportunities lack the protections of academic jobs, such as tenure. For instance, science communication is not categorized and ranked by the vocabulary familiar to academia: student, researcher, professor, chair, etc., and the lack of hierarchical structure in the practitioner field can make it difficult for even the most experienced communicators to be deemed “qualified” to work alongside academics. Furthermore, the controversial nature of much of what occupies the forefront of science communication, such as climate change and natural resource management, can make adequately performing and succeeding at these kinds of jobs difficult. Sometimes, addressing the reality of these contentious topics can cause the institutions that science communicators work for to face backlash from major industries invested in upholding the status quo. Semantic barriers like these lead to a deficit of communicators in research or outreach projects led by some academic institutions, a reality that limits the possible solutions offered by partnerships or coworking between researchers and practitioners.

Since simply adding liberal arts requirements to STEM degrees and fostering more cooperation between researchers and science communicators both offer as many barriers as benefits, Kearns gestures towards a more subtle plan of action that combines the two possible solutions. Instead of grafting on supplementary courses to address the growing communication-centered job market, perhaps pre-existing elements of these degree requirements

can be expanded upon. For instance, Kearns speculates on how the writing expectations placed on science scholars could be made applicable given the current trends in employment: “Scientific writing for journals or reports does not always easily transfer to other kinds of writing, but it could be taught in a way that does” (34). Science research papers typically have a rigid structure and specialized vocabulary. While writing to those specific parameters has few implications outside of science research, the ability to write within a framework or outline and understanding the value of fluency in disciplinary jargon is about as transferable as a skill can get. Similar lines of thought can be applied to the artistry and graphic design behind creating effective diagrams, or the public speaking elements of science research symposiums. Perhaps the clearest and most effective way forward isn’t to teach STEM students arts and language, but to teach them STEM concepts in a way that is more widely applicable.

Importantly, the educational tool that Kearns uses to exemplify the many trials and limitations of science communication is narrative. The book consists primarily of stories collected from science communicators throughout the wide and varied field, often touching on the scientists’ life stories and personalities in the process. Many of her conclusive paragraphs begin with sentences like, “As the narratives throughout this chapter indicate” (127), naming and solidifying this modality. Kearns uses these stories to anchor her arguments in reality.

When Kearns isn’t following the contours of one of her colleague’s journeys throughout their career, she strips reality to its bare bones, fictionalizing common experiences in her field to point out repetitive and relevant problems before tackling how to fix them:

A tenured professor from a major research university stood in the front of a room of people gathered to learn more about her recent work. Her research was on a topic that affected them directly... the questions from the community members rolled in. The first few were

straightforward enough... But then, as can happen in community settings, the mood in the room began to shift. A woman stepped forward to ask a question that led the conversation in a contentious direction about local politics; another person stood in the back of the room, appearing angry, although it was unclear if the reason was related to the presentation or the question... There comes a critical moment when all the preparation in the world at giving a good talk fails... It is in those moments that the need to perform well gives way to the need to relate well. (79-80)

In a way, this sort of condensed, generic portrayal of a common experience in science presentation showcases Kearns' sensitivity to narrative structure. Much like the hero's journey provides a model for the plot of many novels, Kearns distills the experience of a bad presentation down to its major plot points and archetypal characters. This framing sets the foundation for her later arguments about how to avoid following this kind of plot, while grounding it in the emotional, relational, uncomfortable reality that justifies the book itself as an answer to these recurrent and recognizable kinds of problems.

Literary devices are far from the only kind of humanities-based interdisciplinarity that the scientific outreach community could benefit from. Historical context can severely alter the reliability and tact of science communication efforts. Exercises from performance arts are often employed in science communication workshops. Visual art, unburdened by the conventions of language, can articulate lessons that resist being put into words.

Lacking these interdisciplinary methods can result in harm, as ecology doctoral candidate Mila Marshall's work shows. Her career centers around connecting the Black community with nature in a way that honors her heritage. Acknowledging the historical reality of the Black community necessitates understanding the many barriers to feeling safe or rewarded by nature

that have arisen as a result of racist violence and slavery. Marshall shares, ““I never wanted to hug a tree - I grew up with images of Black people being lynched. We have to talk about the woods in a way that doesn’t make people feel anxious. That means conversations about the history of Black people in the outdoors and acknowledging how Black people can feel about science because of things like the Tuskegee Experiments”” (66). Marshall initially viewed woodlands as a center of danger and discrimination, but her career led her to understanding both the truth of these fears and the importance of building bridges back to nature not to rewrite history, but to heal the future. The essence of Marshall’s approach to community engagement is at odds with typical conventions: ““These days, people end up wanting to connect Black people with the land through community gardens. But that creates more work for people who do not need more work... Why limit the landscape, and people, to food production? Black people deserve wetlands, prairies, and woodlands too”” (65). Community gardens are often the answer to creating space for nature in urban environments, but the fraught relationship that the Black community has with working the land has rendered this typically successful measure both counterproductive and tone deaf. A grasp on culture and history are imperative for productive scientific community outreach.

At several points in the book, Kearns and others recommend acting exercises as practice for effective communication. One section explores how law students are exposed to the interviewing process through staged examples “teaching interviewing is so complex that it’s hard to convey in a lecture, so she has students do mock interviews” (119). In another passage, trained actors are brought into medical schools to help students learn how to interact with their patients: “The ‘patient’ is recruited and trained to act out a set of symptoms that can help students learn experimentally” (120). Similar dialectical theater methods have been used by Kearns and her

contemporaries to help teach science communicators how to respect and understand their clientele when it comes to changing someone's flawed perspective. She describes an exercise where one science student is instructed to pretend to be a flat earther and another must coax them out of their ignorance. Another workshop centers on improv skills in science communication settings as a path to fruitful conversation and collective well-being: "Science communication at its best is a relational art form. You have nothing except what's created from the dialogue with the other" (187). The performativity and conversation inherent to the art of science communication is clearly grounded in the theatrical tradition, which is why Kearns and others are so aware of the educational value to be found in acting and improvisation activities.

In cases where turning to theater, or even language, fall short, one of Kearns' interviewees turns to visual art. Art historian and environmental humanities scholar Rina Faletti curated a showing of vintage photographs of Californian construction workers building the state's water system in the midst of a contemporary debate about droughts and water insecurity. She calls the photographs, as well as other art pieces that can aid in heated debates more broadly, "boundary objects" and uses them to ease tensions and make space for constructive communication: "Faletti's approach of using art, in this case industrial photographs, to create a common language amongst a group of people who might normally struggle to talk is just one example of a way to introduce nuance into a highly polarized debate" (143). Visual aids serve as a vehicle for information free from the constraints of language, offering a significant avenue for addressing contentious subjects in science communication efforts.

Understanding the socioemotional context of research wouldn't just be beneficial to outsiders but to researchers themselves. Scientific procedural training is often given with the same lack of human-centered context that characterizes Padian's "anti-narrative." One marine

biologist shares how difficult it was for her to sacrifice the often delicate and unique organisms she studied: “Killing her research subjects in the process was difficult and never merited discussion in her training of professional life... ‘I had compassion for them, I grieved for them... I just know for me they were special, and killing them was something that bothered me’” (61). This disconnect between tasks on the job and valuing the creature you must kill arises as a plot device in *Intuition* as well. Cliff uses alternative methods of sacrificing his lab mice, and that inconsistency is one possible point of the miscalculation that led to inconclusive results in his research. He was expected to use a more physical, invasive approach, but chose a less involved method due to his emotional investment in the mice: “He would have to break their necks, of course, and yet these six mice were absolutely well. He hated the idea of breaking the bodies now so wonderfully cured. He had healed these animals. First he’d brought them close to death, and now he’d brought them back. An overwhelming, woozy desire came over him to see the mice intact. He took one mouse and put it in the clear plastic chamber that served as the CO2 chamber” (68). This decision to deviate from the procedure is where the unreliability of his end results began. If Cliff’s emotions surrounding the nature of the recommended sacrifice procedure had been addressed prior to the collection of his data, much of the conceit of the plot would be resolved. In practice, structuring the methodology of a research plan around the comfortability and morality of the specific scientists carrying them out would lead to less errors in the process, leading to more consistent results. It also would alleviate scientists’ discomfort.

One case study puts the value of narrative in the presentation of science research into sharp focus. Marine biologist Sarika Cullis-Suzuki recollects her presentation to the UN on fishery management: “The results of her research indicated that the organizations were not performing particularly well, neither in terms of the measures they said they were taking nor in regard to the

sate of the fish stocks they were set up to manage” (71). This claim is simple enough. However, the audience at her presentation was made up of individuals with financial incentives to keep things the way they are: “Just after her talk, a diplomat raised his hand to tell her ‘just how wrong’ she was” (71). Of course, the diplomat’s ignorant complaint likely has little to do with the methodology of Cullis-Suzuki’s work and more to do with the inconvenient implications of actually following her suggestions. To alter the fisheries’ protocols could mean re-training fishery workers, purchasing expensive new machinery, and even altering legislation or regulations surrounding the environment. This experience was understandably surprising to Cullis-Suzuki: “She herself was also upset because many of the comments and questions reflected an unwillingness to truly engage with her research results” (72). This detail—that the audience of Cullis-Suzuki’s work were not at odds with her results but with the way her data conflicted with the story they were trying to tell—is a key distinction. Cullis-Suzuki was reporting cold hard facts, disconnected from emotion, politics, and morality. She was not arguing that the fishery management was bad or wrong, just that their practices were not up to standard. All of that may actually benefit the fish populations, it is true, but it’s so much easier to do nothing. Had Cullis-Suzuki gone into her presentation with a clearer awareness of the story she was telling her audience, and more attuned to the story that her audience was already invested in, she would have been more prepared for these criticisms.

This real-life story is eerily similar to Robin’s fictional presentation in *Intuition*, and both situations connect to Padian’s conception of the scientific anti-narrative. In both instances, scientists present valid research and are rebuked not on grounds of factuality. Rather, their research meets with suspicion due to social, financial, and emotional context—or, rather, due to the researcher’s unwillingness to place their research in these contexts. Avoiding any connection

between research conclusions and real-life narratives is a typical fixture of the field, but it can do more harm than good: “Many scientists think that it’s disingenuous to ‘tell stories’ about their research, that this is an unnatural way to explain what they do. To the contrary, the ‘anti-narrative’ of most scientific papers obscures understanding by all but specialists in a sub-field. Narrative is not only natural but necessary” (Padain). In practice, this means that both Robin and Cullis-Suzuki would have been better prepared to face criticisms if they had been more cognizant of the story their research told.

In much the same way that minute aspects of science and math-related processes, such as numerical iteration and open-ended research questions, can lead to new and useful narrative structures, using narrative in science communication leads to better procedures, presentations, and publications. Applying scientific findings to real-life projects and policies often necessitates an awareness of historical context, of the performative and rhetorical aspects of research presentation, and of how research fits into, or reshapes, already existing narratives. Whether a scientist is looking to connect their community to nature, share their findings at a symposium, or navigate complex methodology in animal trials, their lives could be made easier by considering the skill sets developed in writing and reading novels.

Conclusion

After reviewing contemporary literature, considering negative and positive methods of using the novel as a vehicle for interdisciplinarity, and analyzing real-world applications, a pattern comes to light. Narrative, storytelling, characterization, and communication are not just devices that, when used well, lead to the product of a particularly engaging novel. Mastering these skills and knowing how to effectively apply them to disparate, unfolding areas of STEM fields can be a powerful way to store and transmit information, circumventing the years of studying that may otherwise be required to fully understand complex or niche subjects.

Expertise in a given discipline is not necessarily conducive to writing a “good,” or perhaps a better word would be “useful,” interdisciplinary novel. *The Love Hypothesis* was written by a neuroscience professor with no academic background in writing, yet the fashion in which it deals with science remains surface level at best. Allegra Goodman, on the other hand, penned *Intuition* without an academic background in science. Ullman, an uncommon case, falls in the middle—a deft novelist and respected software developer. The point of a good interdisciplinary novel is not to demonstrate the author’s knowledge in a particular discipline. Rather, it is to show that the kinds of thinking and working that any given discipline uses can be understood by anyone, if only put into the correct narrative form.

Novels like *The Bug* and *Intuition* go above and beyond simply rendering the stories of experts in their respective fields; they allow the characters to step into the narratives of the various subjects they work on. Berta and Ethan metaphorically become data input and a faulty computer program respectively, and Robin takes on the role of a lab mouse. Putting the characters in the shoes of their subjects shows that the isolated perspective of the researcher or

programmer is really only one element of a much more complex series of concurrent processes—even in an insular tale restrained to one workplace, one research project, or one program.

It's important to note that appraising *The Love Hypothesis* by the usefulness of its plot's scientific grounding is ultimately secondary to the text's central goal, and the implications therein give a broader picture of what a novel can or should do. *The Love Hypothesis* never promised to give readers a better, more nuanced knowledge of cancer research. It promised an exciting, compelling love story. Yes, its scientific setting is simply an interchangeable backdrop for the romance. However, that's not necessarily a defect of the text. If the love story actually is effective enough to thrive even after being translated across disciplines, if Olive and Adam are still compelling as coworkers at a literary magazine, or a history museum, or a circus, then it's only a testament to how attention-grabbing the core of their story is. *Romeo and Juliette* is just as heart wrenching whether a performance is put on in a different setting, modernized, genderbent or not: same concept.

Whether or not *The Love Hypothesis* is actually an example of such an enduring love story is an entirely separate question, but the point stands. There will never, and should never be, a world where the central conceit of every contemporary novel is to wring out every bit of value and narrative complexity that can arise from amplifying aspects of its main character's careers. However, science is omnipresent in *The Love Hypothesis*. If an author is going to represent another discipline to such an extent, it must be done with purpose.

To its credit, *The Love Hypothesis* is at least attempting to counter the homogeneity in contemporary literature, as seen in the case study of Sally Rooney. She is seemingly unable to write a main character who is not an author, English teacher, or literature scholar. She's the first to admit that this lack of variation is not doing the art of the novel any favors. However, she still

writes fantastic novels. Challenges to the form have their applications, but the form is the form for a reason. There's room in the world for both dependable marriage plots between English teachers and sharp, unique tales of researchers on bookstore shelves. It's just that in reality, the former is much more numerous than the latter.

Just as in the field of literary fiction, the real-life world of science faces a problem of insularity. People are reading fewer novels and they're believing more scientific misinformation due to the increasing barrier to entry in both fields. Although an unwillingness to pick up a novel is a little less detrimental to society than denying climate change or vaccine safety, certainly neither phenomenon is good. It's not always going to be pretty, but breaking down this disconnect in both reading and science is a worthy effort. One must shatter an ugly rock to unearth a sparkling geode.

Whether or not individual authors find the toolbox of interdisciplinarity outlined in this project particularly useful to their own ends, going through the effort to discern and clearly articulate various methods of telling a story borrowed from the hard sciences is valuable in and of itself. Fact and fiction are not separate categories but a Venn diagram. Understanding how and why they intersect is the key to effective interdisciplinarity.

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