CRITICAL READING
IN THE LIBRARY OF BABEL

Steven Hendricks & Brian L. Walter
Steven Hendricks is a fiction writer and a visiting member of the faculty at The Evergreen State College.
Brian L. Walter is a mathematician and a member of the faculty at The Evergreen State College.

> *(I know of a wild region whose librarians repudiate the vain superstitious custom of seeking any sense in books and compare it to looking for meaning in dreams or in the chaotic lines of one's hands…. They admit that the inventors of writing imitated the twenty-five natural symbols, but they maintain that this application is accidental and that books in themselves mean nothing. This opinion—we shall see—is not altogether false.)*
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> —Jorge Luis Borges, "The Library of Babel," *Ficciones*

> *…the decisive moment of literary life will be that of reading.*
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> —Italo Calvino, "Cybernetics and Ghosts," *The Uses of Literature*

In Jorge Luis Borges's famous Library—also called the universe—the search for meaning is both infinitely promising and eternally futile (just like a freshman seminar!). Borges included "The Library of Babel" in a collection titled *Ficciones* in 1944. At the time, he worked under depressing circumstances, performing menial work in a library. Borges would later be appointed Director of the National Library in Argentina until he resigned for political reasons; at the time of his appointment, he was almost completely blind. Borges's work, including a range of short fiction, essays, and lectures, earned him much fame during his lifetime; he was awarded the Formentor International Publishers Prize jointly with Samuel Beckett in 1961, followed by many more prizes throughout his career. Much of his work, including stories in *Ficciones,* has been considered anticipatory of techniques and obsessions of postmodernist fiction: nested and often deceptive layers of reality, self-consciousness, and innovative use of genres.

We recently pulled an unsuspecting group of first-year students at The Evergreen State College[α] through Borges's *Ficciones* and a number of other texts with the innocent-sounding proposition that we would look at literature with a connection to mathematics. At first blush, the connection seems purely curricular: first year students, basic skills. In reality: anything but.

Integrating Disciplines

At Evergreen, we take very seriously the power that integrating disciplines generates. In fact, there are no departments, and faculty members can teach well outside of the discipline in which they were hired. After all, there's nothing sacred about the traditional divisions of study. Imagine, then, aside from being the broadly defined "liberal arts," if mathematics and literature, or all arts and all sciences, were regarded as, practiced as, and truly felt to be unified studies. For one quarter, our students faced this alternate reality. Here, mathematical concepts like recursion, infinity, combinatorics, and formal logic are the keys that unlock stories and provide the impetus for fiction writing. Here, the creative process is a laboratory where the emphasis is not on waiting for inspiration but on experimentation and discovery. Here, mathematics is rife with ideas that defy reason and calculations that boggle intuition.

What we hypothesized and, along with our students, found in abundance were not only an incredible range of examples that connected mathematical and literary ideas, but

[α] *The Evergreen State College is an alternative public liberal arts college in Olympia, WA. Students at Evergreen usually take full-time interdisciplinary programs led by one, two, or three faculty. Students face no curriculargraduation requirements and receive no grades. Instead, they are encouraged to explore a variety of disciplines within their programs. They receive narrative evaluations and write evaluations of their own achievements.*

also an essential overlap of skills and principles that solved some deeply rooted problems that students have in becoming critical readers.

Common Misperceptions

Students come to literature with misconceptions about where literature comes from and what it's for. Typical are some of the student responses to "The Library of Babel": Borges was bored, was crazy, was trying to sound smart or "win some award or something." In other words, any difficulty they have in accessing the meaning of the text they blame on the author. Of course, they've been learning this all their lives from the responses they get to the writing they've done. Teachers read their work (creative or otherwise) in order to tell them what is wrong with it. The comments they receive emphasize their failure to provide for the reader. So, when they read, they expect to be served; they have an ingrained belief that the writer's job is to create a transparent window through which to view the action and maybe the symbolic properties of a story.

Here we've arrived at the other problem: story. Everyone loves stories; stories are like Flintstones Vitamins for the imagination. We find it irresistible to infer from any sequence of words or sentences a narrative—our brains are wired for it. But literature is not a collection of stories, nor is it the art of stories. Narrative belongs to all the arts equally, and what each art gives to our storytelling capacity is a unique and powerful medium. In our case, the medium is language; language is the material of literature. Until students see writers as crafters of language instead of tellers of stories, they remain unable to see literature critically or even to gather the full force of its meaning and its unique pleasures.

Looking Through a Mathematical Lens

Mathematics offers students of literature a model for viewing language as a material. Mathematics involves translating ideas into a symbolic language that then must be dealt with on its own terms, independent of the original ideas. The translation is not complete; crucial decisions must be made about what is relevant and how it is to be represented. Working with the resulting abstractions, one is concerned with essentially linguistic structures and interrelationships, just as a writer crafts a text according to literary and linguistic significance, rather than in obedience to a story.

What we want to emphasize is not so much the necessity of mathematical thinking to critical reading or to any particular pieces of literature; instead, we want to indicate the overall *usefulness* of mathematical thinking to the study of literature, much as one would argue that an understanding of psychology can aid in understanding the subtle composition of fictional characters.

"The Library of Babel" provided our students with an introduction to conceptual territory that would prick the fundamental barriers they had to critical reading. The Library is described with—what else?—mathematical precision:

> The universe (which others call the Library) is composed of an indefinite, perhaps an infinite, number of hexagonal galleries, with enormous ventilation shafts in the middle…. Twenty shelves—five long shelves per

> side—cover all sides except two; their height, which is that of each floor, scarcely exceeds that of an average librarian. One of the free sides gives upon a narrow entrance way, which leads to another gallery, identical to the first and to all the others…. In the entrance way hangs a mirror, which faithfully duplicates appearances. People are in the habit of inferring from this mirror that the Library is not infinite…; I prefer to dream that the polished surfaces feign and promise infinity…. Five shelves correspond to each one of the walls of each hexagon; each shelf contains thirty-two books of a uniform format; each book is made up of four hundred and ten pages; each page, of forty lines; each line, of some eighty black letters (79-80).

The fundamental laws of the library, the narrator reveals, are rooted in the arbitrariness of the written alphabet and the combinatorial possibilities of "the period, the comma, the space, the twenty-two letters of the alphabet…. Everything that can be expressed, in all languages…everything is there" (82-83).

Our students' initial response to Borges's descriptions was incredulity; they blamed Borges for the non-narrative, twenty-five-cent word-bundle of concepts they saw in the text. They faced the material of language, both in the fictional library and in the text itself, employed without many of the conventions of dramatic storytelling. They found it opaque; they could not discern any wine through the elaborate goblet of the language. They saw only a distinct lack of story. They were able to rest comfortably in this reading because they had safely removed themselves, their imaginative, active reading selves, from dealing with the text; in their place, they invented a boring, pretentious old Borges.

It's tempting, faced with such reckless defamations of the revered Argentinian, to hammer one's fist with all the fury of the literary elite, "It's BORGES!" But that would be the exact opposite of our intentions; it would only encourage obeisance to received ideas and give students the message that the meaning of literature may only come from the author.

The incomprehensible completeness of Borges's library is made possible by the application of mathematical structures to the arbitrary signs of written language. Aside from monkeys typing Shakespeare, we are rarely asked to think of language as arising from non-intentional processes. Mathematics, though, makes it easy. One is immediately engaged in the attempt to comprehend the vastness of the library. Given the 25 basic symbols, combined in every possible way within the given limits of each book, there would be on the order of $10^{1834097}$ books in the library (and *that* without taking into account the printing on the spines of the books). Comparing that with the number of atoms in the earth and particles in the universe, on the order of 10^{50} and 10^{72} - 10^{87}, respectively, students begin to sense the immense expressive capacity of numbers and the inconceivable potential of language. Even though the vast majority of books are apparent gibberish, it's undeniable that among the seemingly random volumes some will make perfect sense, and, in fact, somewhere, every conceivable book exists. Yet no *author* exists.

Etiology of Meaning

Where does meaning come from? Students wrestle with the nature of arbitrariness, that thousand and first monkey, as it were, and begin to think about how words mean and what meanings are possible with language.

> I can not combine certain letters, as *dhcmrlchtdj*, which the divine Library has not already foreseen in combination, and which in one of its secret languages does not encompass some terrible meaning. No one can articulate a syllable which is not full of tenderness and fear, and which is not, in one of those languages, the powerful name of some god (86).

In these books, meaning is entirely dependent on the reader's frame of reference. Under one (perhaps not very useful) interpretation, the symbol 'X' might represent the full text of the King James Bible; under another, it might instead stand for "metempsychosis" or "See Spot run." or "Love, soft as an easy chair." Regarding the question, "Where does meaning come from?", "The Library of Babel" clearly demands that readers must discover it, not by perceiving an author's intentions, but by accepting that meaning can only be created through engagement, playful and serious, with the abstract and inherently meaningless material of language.

The erroneous assumptions students make about Borges are circumstantial; any challenging work with some opacity of language provokes students to judge and criticize the author. To say that the author they attack is a phantom they've created is overly simplistic, but it will suffice. What they are really avoiding is being active readers: readers who work, who imagine, who knowingly construct a text. Our students were looking for something else in Borges, for the dramatic or symbolic elements they'd been taught to appreciate or identify in literature. They criticized the author as a way of resisting the responsibility to create meaning.

Borges's relatively simple experiment, though brilliantly elaborated, ultimately forces students to identify themselves with the strange and melancholy Librarians, particularly the narrator, who, it would seem, finds some comfort—an "elegant hope"—in the possibility of a pattern in the potentially infinite chaos of the hexagons. By this identification, they are required to consider their relationship to texts, texts made of language, words on the page, and how they make meaning from them.

While mathematics gives them their initial mastering of elements of the text and therefore a new form of success in reading, it also initiates them into a unified conception of literature and mathematics as symbolic systems. The power of each rests in the perfection of representation and in abstract structures that convey meaning.

In each of the following examples, mathematical concepts are presented that can provide students the proper frame of reference to comprehend the text behind the story. The works in *Ficciones* return again and again to some of the same mathematical themes: recursion, combinatorics, infinity, deduction, equivalence. Perceiving them as such allows students to understand these elements as the deliberate foundation of the texts and therefore as keys to their structure and meaning.

"The Approach to Al-Mu'tasim"

In "The Approach to Al-Mu'tasim" the protagonist, a student, finding himself "among people of the vilest class", observes something higher, something nobler in one of the men he meets. He concludes that this goodness is an echo of another person. "Rethinking the problem he arrives at a mysterious conviction: some place in the world there is a man from whom this clarity emanates; some place in the world there is a man who is this clarity" (40). The student sets out to find the source of the clarity of which he has seen only a glimmer.

The task Borges has set for his student is not unlike the task of deducing the shape of a rock by examining the ripples that it makes when thrown into the far side of a pond. And yet neither task turns out to be impossible; Borges's student finds the source of clarity, Al-Mu'tasim, just as one can sometimes glean information from ripples in a pond (for example, the location of the rock that caused them). More important than the feasibility of accomplishing such a task is the question of attempting it. In both cases the question is one of reconstructing an object from a transformed version of it, and this is one of the mathematician's primary tasks. In mathematics the transformation is often a reversible one—we encode messages and later decode them, for example—but the principle is the same.

Viewed another way, the student's search for Al-Mu'tasim is a process of abstraction. Starting with the basest example, he works his way up the chain of people leading to Al-Mu'tasim, achieving more clarity with each step. Compare this with the mathematician's journey from concrete instance to abstract principle. Beginning with a particular problem or example, the mathematiciain seeks to winnow the base details from the underlying principle; s/he seeks the fully abstract object of which the starting example is just one imperfect reflection.

“The Circular Ruins”

Douglas Hofstadter's "Little Harmonic Labyrinth" in *Gödel, Escher, Bach: an Eternal Golden Braid* features a story within a story within a story within... It nicely introduces the idea of recursion, forcing the reader to pay attention to the idea of levels of information. We're very good at keeping track of this sort of thing in our daily lives—we don't (often) confuse characters in the books we read with people in the real world, for example. This same idea is vital in mathematics. Recursion and recursive processes, and the closely related idea of mathematical induction, are part of the very foundation of mathematics.

Borges plays with such processes in "The Circular Ruins." Borges's protagonist, a wizard, wants to break the rules that keep different levels from mixing; "He wanted to dream a man; he wanted to dream him in minute entirety and impose him on reality" (58). He succeeds in doing so, and he takes pains to prevent his creation from discovering his origin. In the end, though, the wizard discovers that he himself is someone else's dream, encouraging us to ask: who is dreaming the wizard? And who is dreaming that dreamer? Looking down the chain instead of up it, we can imagine that the wizard's creation might, in turn, dream his own creation, who might dream another, and so on, spawning an unending recursive chain of dreamers and their creations.

This is precisely the nature of mathematical induction: the counting numbers form an unbroken infinite chain of succession, and we can set an infinite process in motion by simply ensuring that each individual—be it a dreamer or a counting number or a falling domino—will give rise to another. Thus Borges gives us a window into mathematics, and here neither the fiction nor the mathematics is in the superior position; understanding mathematics helps us to appreciate the story, just as analyzing the story helps us to understand part of mathematics.

“An Examination of the Work of Herbert Quain”

The experimental novel described in "An Examination of the Work of Herbert Quain" takes us into the domain of Combinatorics. To read the novel, the reader must make two choices, with three options each time. Hence there are 3 x 3 = 9 different possible outcomes (by the Multiplication Principle: if you have m options for your first choice and n options for your second choice, then you have *m* x *n* options in all). That there are nine outcomes is hardly groundbreaking, with or without the Multiplication Principle—after all, one can simply count the number of ways to get through the diagram included in the story. However, there are some meaningful nuggets of thought that can accompany this observation. If the reader isn't warm to the Multiplication Principle, s/he might notice that any particular second choice determines the entire path through the tree, meaning that one can count the number of possible second choices (nine, as above) instead of tracing one’s way through the tree nine times. This pattern of reasoning is an even juicier mathematical concept: the reader who makes this observation has constructed a correspondence between paths through the tree and possible third chapters in the tree.

“Funes, The Memorious”

The title character of "Funes, the Memorious" gains perfect memory, so complete that even two views of the same object at slightly different times are, for him, utterly distinct. For the rest of us, it is inescapable that a sword viewed from the side and viewed from the end are the same object; not so for Funes. The mathematical version of sameness is called equivalence: two items are said to be equivalent if they are, for the purpose at hand, functionally the same thing. For example, 2+2 and 2x2 are, for most purposes, identical, so we might generally regard them as equivalent. They are not quite the same thing, though; we use a plus sign to write down the first one but not the second, and it is not difficult to imagine a situation in which that difference would be meaningful (such as trying to type them on a typewriter with a broken + key).

The notion of equivalence is crucial to all of mathematics. It is the mathematician’s way of saying what different objects have in common; it allows us to rise above the tedium of specific instances and examples and instead deal in properties, categories, concepts. Abstraction itself would be impossible if we could not sometimes regard distinct objects as the same. Funes's memory splinters objects into thousands of distinct observations, drastically altering his ontology to one in which objects do not persist through time. His inability to consolidate sense impressions into objects in the usual way deprived him of abstract thought. As Borges wrote, "In the overly replete world of Funes there were nothing but details" (115).

Conclusion

> *The labyrinth is made so that whoever enters it will stray and get lost. But the labyrinth also poses the visitor a challenge: that he reconstruct the plan of it and dissolve its power.*
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> —Italo Calvino[∝]

Our argument is intended to suggest the efficacy of using mathematical concepts in tandem with literary studies as a way of introducing students to the abstract dimensions of textual analysis. It's worth acknowledging that the term *abstract* may seem at odds with the simultaneous claim that such thinking is driven by recognition of the *material* nature of the text. There is no contradiction here. The abstract patterns and concepts that are so well presented through mathematics *are* the material of mathematics, its symbolic systems and its tools. Mathematics therefore provides an excellent model of the union of form and content, material and idea. In literature and in the reading process, all ideas, all contents, occur in the mind of the reader and are best considered as separate from the text. Such an assertion is not mere theoretical sophistry; it forces students to ground their readings and their judgments in specific analyses of the language in the text without

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[∝] The two quotations from Italo Calvino are from his 1967 lecture "Cybernetics and Ghosts." Calvino, an Italian born in Cuba in 1923, was a member of the *Oulipo*, a group of mathematicians and writers dedicated to research and development of mathematical constraints and procedures for generating "potential" literature. In his lecture, Calvino poses thesis and antithesis to demonstrate the similarity of two conceptions of literary creation; the combinatorial play of a literature machine, capable of producing literary masterpieces by automatic procedures, is shown to be none too different from the creative processes that, Calvino imagines, constitute the haphazard development of folk tales and myths, products of the playful unconscious.

recourse to a "story" inspired by it, a substance composed of the same presumptions as the phantom Borges.

Obviously, some texts make the application of mathematics easier and more appropriate than others. Borges's makes it very easy, indeed, by consistent and clever use of concepts that indicate the philosophical and very humanist nature of mathematical thinking. Borges would seem to live in that same alternate reality where disciplines have more in common than not. "The Library of Babel" facilitates meditations on infinity, combinatorics, and abstraction while in the maze of language, meaning, religion, and philosophy. After encountering that story, and others in *Ficciones*, students reconsider the shape of fiction, the nature of mathematics, and, most importantly, how they read—where meaning comes from.

Teaching Borges in this way doesn't require a degree in mathematics. In fact, once the associations to mathematics are made, Borges teaches us a good deal by his use of them. The concepts we explored are well beyond the terraces of traditional liberal arts mathematics, but are readily accessible at an introductory level. We used Hofstadter's *Gödel, Escher, Bach: an Eternal Golden Braid* and *The Language of Mathematics*, by Keith Devlin, as our sources for mathematical content. Though concerned with complex areas of mathematical inquiry, these texts are not focused on computation or formulae; instead, they provide rich and textured looks into the questions that inspire mathematicians and the principles that guide their work.

Our students concluded their study of these mathematical principles and the abstract approach to analyzing literature through both analytical and creative projects. As one student comments in her self-evaluation,

> I recognized the power of abstraction both for the reader and the writer: repetition of patterns as a cue of themes and the different configurations of structure, threading the concepts of the piece through on many levels. I learned to utilize tools like charts, drawings, word replacement, and maps to explore the combinatorial effects of these patterns and structures within my writing. —*Heather Russell*

Her comments reflect the assimilation of a very mathematical approach to analysis, one that regards the material of the text as the starting point for all significance and structure.

Under the lens of mathematics, works of literature are those rarest of volumes in the Library of Babel. What significance they hold is locked in a network of words at once meaningless and full of portent. Such is the case with the texts in *Ficciones,* which weave together structurally and thematically, forming complex associations and patterns for students to wander through. In Borges, little is as it seems; the reader can follow Ariadne's thread for ages without certainty—but with amazement.

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