The Science of Story

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Introduction

Sean Prentiss and Nicole Walker

As professors of creative nonfiction, we—Sean and Nicole—teach students to write creative nonfiction. We ask students to consider scene and exposition, to interrogate the complexities of memories, and to consider time on the page. But, creative nonfiction is also one of the most epistemologically pressing art forms. How can we know what we know? What constitutes truth—fact, experience, or consensus? By the mere act of trying to represent ourselves on the page, have we already begun to dissemble? Has that memory we have turned into "scene" to show our story replaced an earlier, truer memory? What form best reflects a particular experience? Does lyric trump narrative or flashback? Can a hermit crab essay best describe how multiple perspectives reflect a common story?

As parents, we are used to hearing our children say, "But why?" But this question is not only a question that children ask their parents. It is also a question that any good student should ask of their teachers. And our students often ask us that exact question. But what if the teacher doesn't have the answer? *The Science of Story* was born out of our desire to understand not only *what* we should do on the page (and what we should teach others to do) but also *why* we should do those things.

The Science of Story strives to understand that question of "But why" by examining what cognitive science (the study of thoughts), neuroscience (the study of the brain), and other sciences might teach us about creative nonfiction and about the human experience. Our sixteen writers delve into recent science to learn how science supports, works against, or adds texture to techniques creative nonfiction writers use. These writers tie this science directly to creative nonfiction and offer ideas on how we continue to evolve and grow as effective creative nonfiction writers.

The Science of Story investigates, essay by essay, foundational ideas of

creative nonfiction and searches for answers to questions that surround creative nonfiction. These essays examine how creative nonfiction works (and how the human mind works) and offer suggestions on how we can understand and use this science to improve, complicate, or expand our writing lives, our craft, and our teaching of writing.

Each essay uses research to create craft essays that live within the Venn diagram that is the human experience, creative nonfiction, and science. Some essays blend the personal with research, while others highlight how cognitive and neuroscience illuminate how and why we write the way we write. Some others use science as a metaphor to examine our writing and our writing lives. All of these pieces are written by creative nonfiction writers who, either through schooling or personal interest, are deeply engaged in exploring how cognitive and neuroscience work in conjunction with creative nonfiction.

This book, in many ways, serves as a *how-to* (by offering suggestions for writers to continue to improve their craft), a *why* (explaining why we might consider doing things, based not on observation but on cognitive and neuroscience research), and a *what-if* (exploring what other ideas might be possible). All of these craft essays are based upon cognitive and neuroscience but explained through the lens of creative nonfiction.

But this book refuses to be prescriptive in telling writers how science commands us to write. Rather, this anthology offers new techniques (or proves old techniques) while also allowing readers to envision new tools to add to their writing lives. Still, what we are most excited about this collection is that these essays ruminate on what science can teach us about what it means to be writers trying to understand and portray the creative nonfiction world of our lives.

2

Bengal Tiger Moments: Perception of Time in the Brain and on the Page

Sean Prentiss

Creative nonfiction is not just a recording of the events of our lives—car accidents, swooning love, the slow building of a remote cabin—but it is also how we remember, interpret, and re-create these events. We have the great big world out there—of people and places and things—and, completely removed, we have our brains cocooned by skulls. Our brains, literally, are shrouded in darkness. The only way our brains reach past our skulls to experience the outer world is through electrical signals speeding down bundled nerves from our eyes, noses, ears, skin, and tongue to our brains. Without these electrical signals, our brain's understanding of the world would be less than black.

Through the brain's processing of the senses, our brains get to live outside of themselves. They get to experience and interpret the larger world. And as our brains experience that outer world, they are forced to perceive time and to use this perception of time to link moments of life into created memories of events. And this is no small thing. Time perception is so important that our brains are born understanding the passage of time. According to psychologist Sylvie Droit-Volet, newborns possess a "primitive" understanding of time and infants as young as one month old react based on the movement of time.[1]

And though humans are born understanding and reacting to time, scientists are unsure where the brain perceives time. Most scientists, including Marc Wittman, a scientist at the Institute for Frontier Areas of Psychology and Mental Health, in Freiburg, Germany, believe that "There is no one area of the brain, or system in the brain, that is solely dedicated to recording the passage of time." Instead, time related processes are

distributed among the cerebral cortex, cerebellum, and basal ganglia, among others, and the brain has a variety of "clocks" that handle different types of brain time including millisecond clocks used for rapid reaction, decade clocks that deal with the physical body, and clocks that deal with memory or predicting the future.[2] Without these clocks, humans could not survive. We couldn't breathe on a scheduled pattern, eat when we needed to, or sleep enough. We'd misplace or run out of or fall through time and die.

But even though we need to perceive time to survive, and though we could argue that time moves simply enough: one second chronologically lasts as long for me as it does for you—the reader of this essay—still, perception of time can vary wildly. Time can appear to screech to a halt when we're bored or worried. And, as clichéd as it sounds, time appears to fly when we are having fun. So although time is universal, perception of time is a construct of the brain. And our perception of time's movement is faulty much of the time. Rather than feeling as if a one-minute experience lasted one minute we often feel as if one minute lasted up to a third shorter or longer.

This faulty perception affects not just our lives but also our writing lives because how we perceive the world around us affects the details we remember and later write in our creative nonfiction. Our nonfiction is most affected by those moments that were so important that they slant our memories. And as we writers realize that these moments are powerful enough to affect our brain's understanding of time, we can use those memoires on the page by lingering in those rich details to make our essays and memoirs erupt with life.

These richest moments arise from three neurological issues. The first issue is fight or flight related experiences. When we live through high-octane moments—like a first kiss in a kitchen in Wayne, Pennsylvania, or the slow spin of a truck on an icy Vermont road, veering toward a tree—time seems to stretch forever before the two lips actually touch or the truck kisses that old birch.

Why does time slow during fight or flight moments?

It doesn't.

It only *feels* as if time grinds to a halt. David Eagleman, neuroscientist and author of *The Brain: The Story of You* and *Incognito: The Secret Lives of the Brain*, performed an experiment to see if time slows during fight or flight moments. Eagleman had people do unexpected freefalls from multiple stories into a safety net. During this terrifying fall, Eagleman asked his subjects to focus on reading flashing numbers on a perceptual chronometer

that showed numbers barely faster than humans can perceive. If time actually slowed during this freefall, the faller would be able to read the numbers on the chronometer; if time didn't slow, the faller wouldn't be able to read the numbers. During all the freefalls, not one person could read the chronometer.

Afterwards, Eagleman asked his subjects to "re-create your freefall in your mind. Press the stopwatch when you are released, then press it again when you feel yourself hit the net." Eagleman found that fallers' "estimates of their own fall were a third greater, on average, than their recreations of the fall of others."[3] People thought the amount of time they were falling was a third longer than it really was.

Scientists suspect time appears to slow because it is evolutionarily beneficial. In moments of danger—let's say a tiger enters the room where you are reading this essay, a Bengal tiger with a light orange coat with white and black stripes, ten feet long from his four-inch-long fangs to his flicking tail, nearly four feet tall at the muscled shoulders, and close to 550 pounds. What do you do? Do you quietly notice the tiger and then keep reading? Do you call to your partner in the other room? *Excuse me, but do you see the tiger by the door? I believe it's a Bengal tiger.*

No, you run.

You fight for the door.

You race past whoever is in the house with you.

You cower in the corner, too frightened to even move.

Or you use your copy of *The Science of Story* as a shield and a nearby pen as a knife, ready to fight to the death.

When we experience fight or flight moments, according to Eagleman, "the amygdala kicks into high gear, commandeering the resources of the rest of the brain and forcing everything to attend to the situation at hand."[4] Brains kick into a higher gear, Wittman adds, "Because of the threatening situation, I am totally aroused, and my internal physiological processes speed up. And so relative to that, the outside world slows down."[5] Therefore, time appears to slow as the brain maximizes the amount of information it accesses through our senses, so we experience a heightened perception so our brains can more intelligently make decisions.

When the amygdala is engaged, not only do our brains work at a higher level, but our memories are also laid down in a way which provides, again, according to Eagleman, "the later flashbulb memories of post-traumatic stress disorder [and PTSD is always born out of fight or flight related moments]. So in a dire situation, your brain may lay down memories in a

way that makes them 'stick' better. Upon replay, the higher density of data would make the event appear to last longer."[6]

Fight or flight related writing can be seen in Edward Abbey's essay, "Havasu" from *Desert Solitaire*. Abbey spent a day in 1949 wandering down Havasu Canyon, slowly lowering himself down the waterfalls until he dropped off one fall and, Abbey writes:

> I hit rock bottom hard, but without any physical injury. I swam the stinking pond dog-paddle, pushing the heavy scum away from my face, and crawled out on the far side to see what my fate was going to be.
>
> Fatal. Death by starvation, slow and tedious. For I was looking straight down an overhanging cliff to a rubble pile of broken rocks eighty feet below.[7]

Abbey finds himself caught on the edge of a waterfall, with a fall to death below and no way to climb out of the pool above. For the next page, Abbey writes about his ideas on how to escape—screaming for help, tearing his clothes into strips, and building a signal fire. Once he realizes those won't work, Abbey tries scaling the vertical rock wall:

> Here I was able to climb upward, a few centimeters at a time, by bracing myself against the opposite sides and finding sufficient niches for fingers and toes. [. . .] Somehow, with a skill and tenacity I could never have found in myself under ordinary circumstances, I managed to creep straight up that gloomy cliff and over the brink of the drop-off and into the flower of safety. [. . .] I discovered myself bawling again for the third time in three hours, the hot delicious tears of victory. And up above the clouds replied—thunder.[8]

Abbey published "Havasu" in *Desert Solitaire* in 1968, nearly twenty years after the near death experience occurred. Yet, Abbey's recollection is pristine and seared into his memory. And Abbey elongates this short moment stuck on a cliff in Havasu Canyon for nearly five pages, highlighting the power of fight or flight moments to stretch time.

Alongside fight or flight related issues, novel experiences also affect how we perceive time. Our perception of time speeds up as we age because for a young child, every experience is either new or was recently new. During our first days of attending school, we ask: How do we get on the school bus and where do we sit? When do we go to the bathroom? Who will be our friend? As with fight or flight related issues, these novel experiences get recorded more richly because every experience is important to our survival; children devote great amounts of brain power to learning how to live in the world.

To a middle schooler, school has become old hat. To a high school senior, school might be the least interesting place imaginable. Once you're my age,

48, you've spent 2,500 days at school as a student and another 2,000 as a professor. Now almost nothing new happens. I commute the same roads to work (County Road to Main Street to Route 12). I teach the same Norwich University students. Then I go home. It's not that I don't love my job. I do. It's just that since so few novel experiences happen each day (each week, month), I don't use much brain power to figure out how to survive at school. The world has become mundane enough that the brain "forgets" most of the new information it accumulates each day because this information is a repetition of what was learned before. That's why I forget what I wore to teach last week but remember what I wore to my first day of elementary school (blue slacks and a blue striped shirt and a bowl haircut).

Before we examine our third issue that skews time perception, let us, for a moment, take a break from thinking about these time related ideas and travel to the Hope Zoo in Kingston, Jamaica, in 1996. It is, as always, a glorious day at the zoo. Families picnic in the gardens. A Caribbean sun shimmering down like diamonds. And we wander around looking at the animals—the ring-tail coati, the pacca, the serval—before we stop in front of the big cats cages. These cages are just that, cages that we can walk right up to. So that is what we do. We walk to within a foot of the cage, which is by far the closest we've ever gotten to a big cat.

The big cats—tiger and lions in their individual cages—are lying down, their backs against cage bars, heads away from us. They flick tails intermittently. We are so close that if we reach out our left hand, we might be able to touch the tiger's tail. So we do that. We stretch our hand out, slowly inching it closer. We are behind the tiger's back so it cannot see us, we assume. When our hand is mere inches from the tail, the tiger—without looking at us—lets out a low, rolling guttural growl that might mean *I will rip these bars down*. We trip over our feet, stumbling backwards. And this moment forever remains etched into our minds even though earlier today and later today some anonymous zoo keeper will bring food to this cage, walk right up (or maybe even *into* the cage) to feed this tiger the same way you or I might feed our dog. One moment is never forgotten because it is new; the other moment is forgotten because it is routine.

An example of a novel moment in writing is in Charles Bowden's devastating essay on humans and violence, "Torch Song." Bowden, at the beginning of "Torch Song," introduces us to the first time he covers a violent crime as a news reporter. This novel experience is rich and sick and brutal and filled with the exact details we expect from a novel experience:

I can't tell much from her silhouette. She's sitting off to one side, her

shoulders hunched, and toward the front is the box with the teddy bears. Or at least I think they're teddy bears. Almost twenty years have passed, and I've avoided thinking about it. There are some things that float pretty free of time, chronology, the book of history, and the lies of the experts. In the early Eighties I went to a [a motel where a child had been murdered] as part of my entry into a world, a kind of border crossing.

It started as the golden light of afternoon poured through the high, slit windows of the newsroom. I had no background in the business and I'd lied to get the job. I was the fluff writer, the guy brought on to spin something out of nothing for the soft features [. . .] One afternoon the newsroom was empty, and the city desk looked out and beckoned me. I was told to go to a motel and see if I could find anything to say.

[. . .] The motel I was sent to was a hot-sheet joint, with rooms by the hour or day, and featured water beds (WA WA BEDS, in the language of the sign), in-room pornographic movies, and a flock of men and women jousting through nooners.

I walked around aimlessly [inside the motel room] and popped open the door of the old refrigerator—shelves empty—and then the little door to the freezer, where two bottles of Budweiser, frozen solid, nestled as if someone with a powerful thirst had placed them to chill in a hurry and then been distracted. I heard the woman's voice in my ear explaining how the mother had gone to work—she danced at a strip joint, one of the new gentlemen's clubs that featured college-looking girls instead of aging women with bad habits—and so was gone when it happened. [. . .] I looked at a big splotch on the cinderblock wall, and she said, "I haven't had time to clean that off yet."

That's where the head had hit, the skull of the toddler just shy of two years, as the man most likely held him by the legs and swung him like a baseball bat. He probably killed the kid out of boredom or frustration with the demands of a small child, or because he'd been bopped around himself as a child, or God knows why.[9]

Later in "Torch Song," Bowden comes to live, for years and years, on the edge of this world of violence and deviancy and sex. He lives a world where reporting on violence becomes an everyday occurrence. These brutal moments lose their power to Bowden. And as they lose their power, Bowden falls deeper into a world of deviant sex. Rather than these deviant sexual moments gaining power, they lose power because he has experienced so much. Bowden writes:

A woman is at the door and she says she has cuffs.

A woman is at the door late at night and we make love, and as she leaves she says she can't see me again because she is getting married in the morning.

Two women are at the door . . .[10]

By the end of "Torch Song," rape, murder, child molestation, and risky sex

become the norm. What was once shocking and novel and powerful becomes nearly, somehow, mundane.

Outside of fight or flight and novelty experiences, we have a third issue that affects perception of time: altered states. This can include drug and alcohol use, dementia, psychological issues (like bipolar disorder), spiritual issues, and medical issues (we call it *chemo brain* for a reason).

Altered states experiences affect perception of time because stimulants like cocaine and meth or depression or anxiety make us overestimate how long an event takes while depressants like alcohol and marijuana or maniac moments make us think an event went by more quickly. Psychoactive drugs like LSD and mescaline may make time speed up, slow down, or become out of sequence.

Imagine a person sitting in their living room. Then they take a psychoactive drug of some sort and sit on their old and weary couch. They look at the painting on their wall. Maybe it is Andrew Wyeth's *Dorothy's World*. Our drug user stares at the image of Dorothy, propped up on one hip in a sea of tan grass, a farmhouse off in the distance. As the psychoactive drugs take effect, our person hears something rustling Dorothy's grass, something that is moving closer and closer to Dorothy, who seems stuck to the ground and unable to run away. The grass parts enough so our drug-affected individual sees the orange, white, and black markings of a Bengal tiger pushing through the dried grass, stalking Dorothy. The tiger draws its face back into a roar that lasts so long that our drug user can do nothing but sit paralyzed on their couch. After what seems like minutes or hours, the tiger lunges toward Dorothy in a blur. Right before landing upon her—our drug user screaming—the tiger vanishes and Dorothy is again alone in her field of dried grass and our drug user is left on the couch, dazed and scared.

An example of drug related experiences can be seen in Jessica Hendry Nelson's memoir, *If Only You People Could Follow Directions*, which deals with Nelson's family's struggle with addiction and mental illness, Nelson writes about an evening and night where she and her friend Jordan drink wine and snort Ritalin:

> We swig back glasses of wine and light cigarettes. "Let's take a walk," I say.
>
> "I can't move," says Jordan. "I mean, I just want to be right here, with you."
>
> We sit quietly, smoking, and I feel my thoughts begin to trip over one another, my heart racing. I watch the old flip clock clicking through those arbitrary numbers, and it seems so loud, that clicking [. . .]
>
> Jordan reaches over and covers the clock with a blanket. It goes silent, which we soon realize is not the same as stopping time.[11]

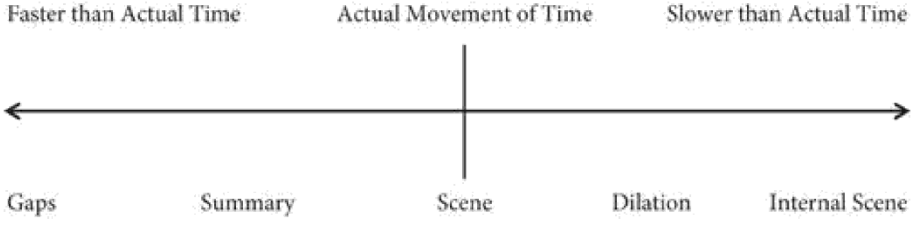
Soon, it is 2:30 am and Jordan is crying as their friend Angel visits. Then time passes in one big leap.

> Here I am, and that sun, which isn't here yet, could show up at any moment unannounced, as it tends to do. The world will start up its endless, painstaking rotations, and all the people will get out of bed. [. . .]
>
> "Oh my God," I say. "Do you know what that means? It means it's late, really late, and soon the sun will come up. I can't bear to see the sun. God, I hate that fucking sun."[12]

In this section, we get a scene where time moves in jumps and starts. It lingers in moments that stretch out and then it contracts as time leaps forward from evening to the middle of the night to the edge of almost dawn. During moments of drug usage, time is not linear but is instead a jumping, fidgety thing, an elusive thing that yawns and accordions and disappears.

Now that we know the major experiences that make brains misperceive time, we can consider how to write these moments in ways that cause readers to also misperceive time. Two ways to help the reader feel the warping of time are by using speed of scene and incident frequency.

Speed of scene is the amount of time it takes a reader to read a scene versus the amount of time the actual event took. Five categories exist for speed. From fastest to slowest they are Gaps, Summary, Scene, Dilation, and Internal Scene.



Gaps are the fastest movement of time. Gaps, as their name implies, leave out many details of an event. Gaps skip over age related moments where we forget things because they are unimportant. Drug-affected moments often have gaps.

Erik Reece, in *Lost Mountain*, offers an example of a gap when in "Acts of God" he writes,

> In 1912, the railroad finally reached McRoberts, a small hamlet that sits near the headwaters of the Kentucky River's north fork. The Northern coal barons had been waiting for decades to get at the minerals in the Cumberland Highlands, and once the tracks were laid, they quickly threw up coal camps

along the narrow valley floors. Elkhorn Coal built nearly a hundred four-over-four houses about ten feet from either side of the only road that leads to McRoberts. Two families lived in each house. There was no indoor plumbing.

Men who had tended their marginal farms traded plows for picks and went to work in the new mines. They made enough to pay rent to the coal company and buy canned food at the company store. The latter would become a symbol of the miner's loss of independence. "Though he might revert on occasion to the ancestral agriculture," wrote Harry Caudill, "he would never again free himself from dependence upon his new overlords." It was in a very real sense that the miner narrating the song "Sixteen Tons" felt that he owed his soul to the company store.

Today, many of the company houses are still standing.[13]

In one line of text, Reece gaps us from 1912 to "Today." Why does Reece skip nearly one hundred years? Because those years had nothing to do with Lost Mountain or with mountaintop removal. Hence, the use of a gap that spans multiple years.

Summary, much like gaps, deals with forgettable nonnovel moments. When using summary, we distill an event down into just important details. Summary can compress months of dating into just a few short lines of text.

An example of summary can be seen in Jane Alison's *The Sisters Antipodes.* In the scene below, Jane is invited to Washington D.C. to have dinner with her former stepfather, Paul. Paul asks Jane how her mother, Paul's former wife, is doing. Here Alison shifts us from scene to summary.

Another pause and jingle of ice, another shift of subject.

"Your mother still seeing—what's his mane—Phil? Bill? [asks Paul of Jane]."

She probably was, Phil or Bill or Bob or Ken or some John or another. Men pulled up in white Cadillacs on Friday and Saturday and took her to dinner at Picadilly, she would dance out all Givenchy, leggy blue dress, bright gap-toothed smile, and what was so hard to work out, as I sat on Paul's slick black chair and dug my feet into that hateful white carpet and looked at all those bright brown eyes [of Paul and his children] and laughing straight American teeth, was the right way to answer, how to know whether my mother would have a positive valence for attracting these men or a negative valence for needing to.[14]

In this excerpt, Alison begins in scene but then moves to summary to skim over details that could be turned into pages of scene in a memoir about the dating history of Jane's mother. Instead, Alison summarizes the men who are entering her mother's life because what matters is not that we come to know each suitor but that we come to know the long line of men as a unit, as a group of unimportant men who enter and leave Jane's life.

Scene matches the actual time of the event. This is closest to the real time of an event. Here the time it takes to read a narration closely matches the actual time of the event. Scenes often come from all the times when our perception is affected—fight or flight, novel, and altered state experiences.

Joy Castro, in *Island of Bones*, offers one example of a move from summery to scene. Our narrator, Joy, tries to convince her mother not to remarry.

> I cry in her room as she dresses, begging her not to do it, but I have no evidence aside from the weird way he looks at us. She's patient for a while, going over the money he makes, the good reputation he has in his congregation—but finally she turns on me.
>
> "I am just about fed up, you hear? Do you understand me? I've just about had it with your bellyaching." She swings the hairbrush in my face. "Why do you always want to ruin everything? Why? One good thing comes along, something that will actually make me happy for once, and you have to start your whining. As usual."
>
> "He's not a good man." I'm still crying. She laughs angrily, throws the brush down on the bureau.[15]

Castro begins this except closer to summary ("I cry" and "begging her not to" and "She's patient for a while") before moving into the moment that is seared into Castro's brain due to the power of the event—the anger bursting from her mother, the threat of the hairbrush in Joy's face, the painful dialog.

Dilation occurs when the reading of a moment stretches longer than the actual event. Dilation is slower—because of the level of detail added—than real life and often mirrors fight or flight, novel, and altered state experiences.

Charles Finn, in his collection of essays, *Wild Delicate Seconds*, dilates a moment when he gazes upon a cougar. In real life, the cougar takes one single step while Finn is watching, a moment that lasts less than a second. From that one second, Finn writes:

> The cougar stops and stands in profile. Large chamomile eyes swivel and loop up into mine. Its tail is drooped in an elongated S, shoulders rounded above the sweep of its back. Powder-puff ears turned toward me and its face is centered around the pink heart of a nose. I can make out the thick lines of its whiskers, also the indent of lips pulled back in their perpetual smile. The cougar lifts its head and dignity oils its fur. It raises a boxing glove paw as if in greeting and I know my one wish above all others is to spend time with one of these cats, to hold and pet one, to hear one of them purr.
>
> The cougar sets its paw down ahead in the snow. It lifts the other.[16]

Finn dilates time so much that we get nine sentences describing a cougar

taking a single step. Finn dilates because this fight or flight moment was so powerful that his five scenes were able to share more information with the brain and the brain recorded the memory more richly.

Internal scene is when a writer stops action and moves from the real world into the brain for thought. Because the writer is no longer experiencing the outer world, there is no perception of time occurring, instead only introspection, speculation, and reflection.

An example of a move from scene to pause to scene is when Joe Wilkins, in *The Mountain and the Fathers*, visits Ed Dempsey to get a scent to help him trap coyotes.

> Ed Dempsey is big as a bear, but slumped and pudgy and bald. He has turned his big body away from me, is studying the rows of shelves along the far wall. He takes a long time. I stare at the stubbly back of his neck, his shoulders rising with breath. He must be remembering, for the shelves are not labeled, and neither are the glass bottles that crowd each shelf: some green, some brown, some purple, some with droppers for lids, some with burnt driftwood corks. I imagine he enjoys remembering, I imagine there is a story that explains each one, which ridge and what kind of coyote and how the rain came. These are Ed's blue-glass stories, these bottles and vials he considers—first this one and then that one, the glass clinking like small bells as he thumbs through them. I don't care how long this takes, how long he spends remembering. I'll wait.[17]

In this vignette, Wilkins introduces us to Ed Dempsey. But then Wilkins wanders into his own mind—and, theoretically at least, the mind of Dempsey. Time halts and we're left lingering in thought, at least until Dempsey's clinking glass bottles yanks Wilkins back to the present.

Along with speed of scene, writers can also use incident frequency to highlight how we misperceive time. Incident frequency is the number of times an incident occurs in the real world in comparison to the number of times it occurs on the page. Three categories exist.

Normative frequency is when the number of occurrences of a real event match the number of times the event is shown on the page. Almost all creative writers often use the normative frequency.

Iterative frequency is when the number of occurrences on the page is lower than the number of occurrences in the real world. The iterative is best used to remove nonnovel experiences. Writers don't need to talk about all the times they've gotten dressed for school. They need only mention those novel days (first or important days) getting dressed for school. Creative nonfiction often uses the iterative frequency to reduce nonnovel experiences.

Repetitive frequency is when the number of occurrences on the page exceeds the number of occurrences in the real world. Repetitive is best used to highlight fight or flight and novel experiences. Writers use repetitive frequency to highlight how an issue is so powerful we keep returning to it.

An example of a repetitive incident is from Tim O'Brien's *The Things They Carry.* In his story, "How to Tell a True War Story," the narrator keeps returning, again and again, to how one of his fellow soldiers dies. The narrator keeps repeating the story because he is trying to exactly capture how to tell this one death moment. Each time the narrator fails. So he tries again. The narrator says:

> This one does it for me. I've told it before—many times, many versions—but here's what actually happened.
>
> We crossed that river and marched west into the mountains. On the third day, Curt Lemon stepped on a booby-trapped 105 round. He was playing catch with Rat Kiley, laughing, and then he was dead.[18]

A few pages later, the narrator says:

> This one wakes me up.
>
> In the mountains that day, I watched Lemon turn sideways. He laughed and said something to Rat Kiley. Then he took a peculiar half step, moving from shade into bright sunlight, and the booby-trapped 105 blew him into a tree.[19]

And a few more pages later, the narrator says:

> Twenty years later, I can still see the sunlight on Lemon's face. I can still see him turning, looking back at Rat Kiley, then he laughed and took that curious half step from shade into sunlight, his face suddenly brown and shining, and when his foot touched down, in that instant, he must've thought it was the sunlight that was killing him. It was not the sunlight. It was a rigged 105 round. But if I could ever get the story right, how the sun seemed to gather around him and pick him up and lift him high into a tree, if I could somehow re-create the fatal whiteness of that light, the quick glare, the obvious cause and effect, then you would believe the last thing Curt Lemon believed, which for him must've been the final truth.[20]

And maybe that is the key with repetitive incidents. Repetitive frequency is rarely used, but it is best used when we need to retell a story over and over again or tell it in new ways as we, the narrators of our own life, search for our final truths while knowing that they might never be achievable.

In the end, creative writers should remember that time is vital, but, still, we misinterpret how long important and mundane events take. It is this misinterpreting that might be most powerful to our writing because once

we understand how and why time is skewed, we can use that skewing to benefit our writing. We can focus on those moments that affect our perception of time so that we affect the reader and how they perceive time in their minds and on the page.

If writers can make readers feel as if time is being summarized and gapped until it might never exist during the quiet moments of our lives, we give them an authentic reality. If we pause or dilate scenes until time stretches nearly forever or repeat a scene again and again, when we live those novel moments, then we allow readers to experience the warped, essential experiences that compel us to write in the first place, to create for our readers an experience of time that mirrors the dramatic elongation of time, especially during those Bengal tiger moments of our lives.

3

Sipping from the Transmitter: Theorizing the "Potential Essay"

Lawrence Lenhart

The most surprising word I've ever encountered was my son's first. After months of sputtering, babbling, incanting—electric with prosody—he came out with it: a word. I won't tell you that word here, now, because maybe it was a secret. Later, when I replayed the syllables—even the imagining can activate the temporal lobe—I was proud of his inflection.

A list of other surprising words:

lighght
see k
Chikin
deathfugue
wordwall
breathturn
icethorn
redgold
silverflamed
heavenmetal
sd
yr
supercalifragiliciousexpialidocious
bababadalgharaghtakamminarronnkonnbronntonnerronntuonnthunntrovarrhounawnskawntoohoohoordenenthurnuk

Some words cannot be taken out of context because they are their own context: brands, surnames, memes, or slurs. At a high-enough frequency, a word, any word, can signal alarm. When whispered, the same word becomes confidential. If repeated: neurotic. In 1968, a word provoked outrage when senators warned Americans that their tax dollars were being frittered away on concrete poetry. Aram Sorayan's one-word poem, "lighght" (that's it, the whole poem), was purchased for *The American Literary Anthology* by the National Endowment for the Arts for $750 (or the equivalent of $5,500 today). Sorayan has said the poem tries to make "the ineffable, which is light—which we only know about because it illuminates something else—into a *thing.* An extra 'gh' does it. . . . It's sculptural on that level." Whether or not "lighght" accomplishes what it sets out to do, I pause every time I see it—on a computer screen, the printed page, a whiteboard, or tattooed on an arm. I get this incredible urge to take out my wallet and throw money at it.

In-demand freelance writers may charge up to $0.30 for each and every word they type. At this rate, my last sentence could fetch $4.50 ($4.80 if you count the hyphenated compound as two). Idiomatically, this practice is centuries-old with two-bit, four-bit, ten-dollar, and hundred-dollar words connoting highfalutin diction. Notice how inflation reappraises the idiom. But the biological value of a word—its neurophysiological worth—has remained constant over time.

"Words are ancillary to content." So says the epigraph to N. H. Pritchard's *Matrix*. Sometimes I think the dramaturgy of diction is the only thing worth fighting for. Like how so many of my sentences sound like an argument with myself, a competition: replacing a word with its better, then its best, recalibrating my diction until I've been accused (just once) of impersonating someone with Tourette's. It's just how I

talk. How to explain that each sentence is a predicament, and I must riff my way back into silence.

I can remember the way my mind boggled when, at Diné College, Orlando White's poetry students showed me the ambigrams they'd been working on. Cognitive scientist Douglas R. Hofstadter defines ambigrams like this: "Calligraphic design that manages to squeeze two different readings into the selfsame set of curves." The gesture transforms the word into a wheel. Turning the paper does not distort its legibility. With its constant morphology, the word seems visually pure. Rendered like this, a word has infinite potential.

"But a word is a bottomless pit," Lyn Hejinian says in *My Life.* It's true that if you take these pages out from beneath your nose, you're probably looking toward crust, mantle, core. Imagine that core, and keep going. That's how deep I beg my diction to go. Words are my favorite sustainable resource. Because they are bottomless, you can extract from them bottomlessly.

Before that first word, my son used to say, "Gauww?!" as he pointed at objects. Every utterance was its own vector. "Book," I obliged. "Gauww?!" "Soap dish." "Gauww?!" "Cat." "Chewing gum." "Asparagus." "Gus!" he estimated. "Good," I said. "That's pretty good."

When I started college, I only knew that I loved words. I wanted to major in them, one way or another. Before committing to "writer," I first tried electroencephalographic (EEG) technician. In a fusty basement in Pittsburgh—five stories beneath the swivel chairs of cognitive-linguistic professors—I smeared dozens of electrodes with conductive adhesive gel. I fit the net of rubber nubbins over the participants' brain regions. After situating the central electrodes, I tugged the headband until the frontal and prefrontal terminals were in place. I shimmied it over the temporal, the parietal, and with one last yank, the occipital. Just like that, the whole scalp was covered by small cylinders that resemble the nozzles fitted to the end of sprinklers. After some brief instructions in the sound-proofed booth—"Here's how to respond," "Here's how to pause," and "Don't fall asleep, really, don't fall asleep, you won't get paid,"—I left the participant utterly alone for the most monotonous ninety minutes of their life. I sat alone on the other side of that booth in the drop-ceiling basement staring at an oversized computer monitor. The only sign of life was the squiggling of brainwaves throughout the test, all carefully time-locked to the display of specific words within sentence after sentence after sentence. This meant I could observe the participant's reaction to each and every word. Watching the neural oscillations, I reimagined that slogan from the Partnership for a Drug-Free America: "This is your brain on words."

When humans encounter words they don't know, they have an involuntary reaction. Neurophysiologist Elvira Khachatryan calls it the "Wait, what?" moment of language processing. Technically, the cognitive-linguistic paradigm associated with "Wait, what?" is called the N400.

Electrophysiologically speaking, when we encounter a word, ions flow in the brain, pushing and pulling the electrons to the surface. It's the quantitative difference between the push and pull (fluctuations in voltage) that generates "potentials." Every time we read a word, there is a weak voltage on the surface of our scalp. I fantasize about someday creating a word that might create an exit wound, surging through bone, pericranium, connective tissue, aponeurotic layer, more connective tissue, and skin. Surely, James Joyce's "onomatopoeia" for the thunderclap accentuating Adam and Eve's Fall ("bababadalgharaghtakamminarronnkonnbronntonnerronntuonnthunntrovarrhounawnskawnt oohoohoordenenthurnuk") was meant to summon this kind of force.

When a potential is measured as a direct result of a cognitive event like language processing, it's known as an event-related potential (ERP). These events transpire in less than a second.

Come to think of it: How would an electrophysiologist even measure the millisecond response to a word like *bababadalgharaghtakamminarronnkonnbronntonnerronntuonnthunntrovarrhounawnskawntoohoohoordenenthurnuk*, considering it takes several seconds to read?

In Len Platt's introduction to *Finnegans Wake*, there is the admission that the book is "virtually unreadable" (a heck of a way to introduce a book someone just spent their hard-earned money to acquire), "not because it has no meaning but, on the contrary, because it allows for such potentiality of meaning—to the extent that some readers have claimed it can mean anything and everything." Platt goes on to point out this is "patently untrue," since the reader can't transform the book into, say, *Moby Dick*—no matter how inventive their interpretation.

While they took the test, I watched the participants' brainwaves cresting and troughing on the monitor. I was on the lookout for unexpected noise or idle electrodes or delta waves. I'd knock on the booth, and the door would swing open. "I'm just here to wake you up," I'd say. "I wasn't sleeping," they often lied. I wanted to challenge them. "I have some data here that says otherwise." Once they left, I'd slosh together a saline solution to clean the electrode net and then save the data before running it through statistical software, which filtered the noise and isolated ERPs like the N100, P200, P300, P600, and especially the N400.

When I read a sentence, there are phantom words, invisibly inked, between the words: alternate linguistic realities—a subconscious matrix of expectations, associations, and aberrations. The phantom words flicker for a few hundred milliseconds before disintegrating. To read like a writer, one must hallucinate even the words that weren't chosen. In the blank slur that is the *interword*, I sense a shortlist of words averted. Like the late comic Mitch Hedberg's joke about "Do Not Disturb" signs, we process and valuate individual words faster than we do sentences.[1] And while it's unlikely that the hotel sign manufacturer intends for polysemy (Greek for "many signs"), the L=A=N=G=U=A=G=E poets of the early 1970s made it their solemn mission. They wrote in a manner that maximized deduction at the paragraph level while minimizing deduction at the sentence level. By "torqueing" sentence structure through unconventional syntax, the authors amplified polysemy, always training the reader's attention on the activity of language, not its meaning.

When I ask my parents what my first word was, my mom says: "Mom." Dad says, "I'm still waiting to hear it." It's his clever way of saying we don't speak the same language, have the same interests, have occasion to talk much at all.

The theory of the "new sentence" (Ron Silliman's now forty-year-old term for it) was really just a recapitulation of the two most influential Steins from the first half of the twentieth century. From Ludwig Wittgenstein's *Philosophical Investigations*: "When I say that the orders 'Bring me sugar' and 'Bring me milk' make sense, but not the combination 'Milk me sugar,' that does not mean that the utterance of this combination has no effect."[2] And Gertrude Stein in *How to Write*: "Within itself. A part of a sentence may be sentence without their meaning." Silliman, failing to find any redemptive theories of the sentence from an entire century of linguists, especially as it might apply to literature, turned to these two, as well as his contemporaries. In "Writing (as) (and) thinking," Hélène Aji notes that Charles Bernstein (a friend of Silliman's) "calls attention to the combinatory nature of language and to the potentialities of deviant combinations." An equally clunky version goes like this: "Poetry is a graphic form of unrighting the publicly codified colocation of a grapheme with symbolized ordinary writing and speech usage and the imaging function of the mind." Likewise, Aji directs us to the automaticity of Lyn Hejinian's process: "The language itself materializes thought; the writing realizes ideas. One discovers what one thinks, sees, says, and as the words unfold in the work, the work, directed by form, extends outward." Elsewhere, Hejinian is charmingly coy: "I am suddenly aware that phrases happen."

First discovered in 1980, the N400 is, (very) technically speaking, a "large negativity with a broad (parietally maximal) scalp distribution, peaking around 400 ms (largest for semantic anomalies, but also present for improbable but sensible endings)"—this according to Marta Kutas, one of the neuroscientists who first discovered the linguistically significant paradigm. In other words—because when re-presenting science, we often need them—when readers encounter a sentence with unexpected diction, their brains react following a certain electrophysiological pattern. In the original article in *Science* (1980), "Reading Senseless Sentences: Brain Potentials Reflect Semantic Incongruity," Kutas and Hillyard use these compositional examples to demonstrate semantic congruity, moderate semantic incongruity, and strong semantic incongruity, respectively. Expected: He took a sip from the *fountain.* Somewhat unexpected: He took a sip from the *waterfall.* Not at all expected: He took a sip from the *transmitter.* Four hundred milliseconds after the reader encounters a misfit word like *transmitter* (or about the amount of time it takes the average person to blink), the entire scalp buzzes with electrical activity, most noticeably at the parietal lobe where sensory and language processing occurs. The stronger the incongruity, the greater the amplitude. This amplitude, this time-locked peak, is language crashing against the brain.

Reading has never been the same since working in that EEG lab. That year, I took to slinking my fingers through my longish hair while reading. I traced each strand to its follicle, thinking I might feel the weak

shock that is "word processing" on my fingertip. It was that watershed year when the global number of text messages officially surpassed the number of phone calls. My long-distance girlfriend wasn't messing around anymore; we pooled our funds and treated ourselves to matching "unlimited texting" plans. Words buzzed into my life, and I found myself reading in places I had never associated with language: elevators, urinals, crosswalks, and queues. Even then, when I read her texts, it was happening: e ach word resulted in a faint electrical flutter on the scalp so that when she was brainstorming via text about her Halloween costume (something about Bohemian discotheque), I was cognizant of an electrical brainstorm of my own. That semester, I read lines of William Carlos Williams, wondering what kind of parietal peaks it must be inducing. When my poetry professor, Ben Lerner, heard about the EEG lab where I was working, he suggested that rather than quizzes, he should just have students submit their brainwave activity from their reading. Enough N400s, and you get an A. Delta waves (sleep), and you fail.

Of course, researchers didn't have creative writing in mind when they first discovered the N400. Rather, they were interested in the potential for the N400 to explain and mitigate reading impairment and language disorders. In the thirty years since the discovery, Kutas and Federmeier describe applications in "language processing; object, face, action, and gesture processing; mathematical cognition; semantic and recognition memory; and a variety of developmental and acquired disorders." In short, the N400 is one of the premiere diagnostic tools for all manner of linguistic conditions.

In his introduction to *The Next American Essay,* John D'Agata writes, "A fetus at eight weeks has developed its ears but not yet the ability to hear. What this means is that anything you read to a fetus will go in one ear, but not come out." And yet, my son's first word was one of the first I ever read to him, prenatally. "[Word]," I said to him. "[Word]," he said back.

My wife, who has never owned a dog, says we can get one as soon as our son asks the question. For a few days, I try to train him to say *dog*. I prolong the phonemes: *duh-aww-guh duh-aww-guh duh-aww-guh daw-guh daw-guh dawg dog.* If only he says it with a pleading look. Like he says, "Gauww?!" It reminds me of Donald Barthelme's story, "Chablis," in which a mother tells a father their baby wants a Cairn Terrier. She knows this telepathically. No language required. My wife makes a rule, though: it must be a complete grammatical sentence.

I often left the lab as it was getting dark, jaywalking toward the secular Cathedral of Learning where my literature class was held. My favorite book that semester was Jonathan Safran Foer's *Everything Is Illuminated*. The secondary character Alexander Perchov is a Ukrainian translator who is notorious for his unchecked use of the thesaurus. Perchov's trials in translation resulted in many surprising phrases. "Pygmy allowance" and "seeing-eye bitch" are just a few of the surprising deviations from the high(er)-cloze-probability words *small* allowance and seeing-eye *dog*, respectively. After class, I wished I could return to the lab, read the playful book while hooked up to an EEG—to see the way an unexpected word jolted me as a reader, forced my cognitive-linguistic sensibilities to be destabilized for a half-second while I found ways to accommodate the dictional aberrations. Instead, I resorted to annoying my girlfriend by reading my favorite paragraphs (sometimes pages!) over the phone. I hear myself now, mansplaining these passages for tens of minutes, foolishly trying to understand an effect that lasted for halves of seconds.

That semester was the first time I heard the word "experimental" outside of a science class. Each time Lerner used it to us—introductory poetry students—it made me skeptical of Creeley, of Spahr, of Williams, and of Rankine. I looked at the sentences, wondering what the poet's hypothesis had been, and whether the syntactic trajectory supported that hypothesis or refuted it. I regarded the clauses as variables, and each word as datum.[3]

With a surname like D'Agata, it's no wonder how the foremost writer of the lyric essay arrived at his genre: look at all the schwas. But let's not forget how ambivalently he titled the oft-cited introduction to *Seneca Review*'s lyric anthology: "We Might as Well Call it the Lyric Essay." Resistant to the nomenclature, D'Agata writes: "'lyric essay' is no less an example of lipstick on a pig—which I think is why you'll find that is has fallen out of favor with a lot of the writers in this book." The lyric essay is an oxymoron, "an essay that's also a lyric; a kind of logic that wants to sing; an argument that has no chance of proving anything." It is a prose that poems, an essay that lyres.

If you look at the N400 on a coordinate grid, you will find it resembles Freytag's Pyramid. There is a

steep incline as it progresses along the x-axis, peaking/climaxing before its attenuation. There is a story behind every N400, some causal concealment. "Tell me the story about the time you took a sip from the transmitter," I beg my students. "Tell me about the time you unlocked a plant, staggered a cloud, prayed a guitar." There's always one per classroom who won't accept the challenge, who thinks it's just stupid. The others, giddy to negotiate their contract with language and memory, are willing to rappel into that bottomless pit.

A decade has passed since the fusty basement. I am reminded by a researcher halfway across the world that all words, not just the "incongruous" ones, elicit an N400, however faint. Even the most straightforward sentence—"I" "want" "a" "dog," for instance—becomes a site of cognitive trepidation. Each word potentiates the ones surrounding it. Each sentence is the site of a linguistic unnerving.

There is a difference between "inventing" a new language and a new *kind* of language. Anthony Burgess, who taught courses in phonetics and literature, developed his own Anglo-Russian teen slang for *A Clockwork Orange*:

> Oh it was gorgeousness and georgeosity made flesh. The trombones crunched redgold under by bed, and behind my gulliver the trumpets three-wise silverflamed, and there by the door the timps rolling through my guts and out again crunched like candy thunder. Oh, it was wonder of wonders. And then, a bird of like rarest spun heavenmetal, or like silvery wine flowing in a spaceship, gravity all nonsense now, came the violin solo above all the other strings, and those strings were like a cage of silk round my bed. Then flute and oboe bored, like worms of like platinum, into the thick thick toffee gold and silver. I was in such bliss, my brothers.

For the most part, the paragraph looks like madman play mad libs with an otherwise coherent English paragraph. A quick surgery of nouns and verbs can restore the semblance of traditional meaning. This uninhibited flex of language can be found in Cathy Park Hong's poetry as well. In his review of *Dance Dance Revolution*, John Yau points out that the speaker (known as "The Guide") "speaks a lingua franca or what she calls 'Desert Creole,' a cacopho nous mishmash of puns, pidgin languages, malapropisms, neologisms, and portmanteaus." The language is "an amalgam of some three hundred languages and dialects."

But these languages, coded or globalized, are altogether different than the language system in *Finnegans Wake.* As Platt describes it, *Wake* "announces a new 'revolution of the word'. . . one that works not to stabilize the world, but, rather, to unfix it in a wild diversity of possible or potential significance." Whether it's virtuosic or incoherent,[4] it is a new *kind* of language.

To call a work "potentially significant" makes that work sound unread, un-understood, or simply undealt with. By and large, we have not met the challenges associated with Joyce's revolution; if we had, scholars would not be publishing articles titled "*Finnegans Wake* for Dummies" in the flagship journal associated with Joycean studies.

Potential energy is *stored* energy. It is the book willing, able, to do its work. It is the word, resting on the page until perceived. The transfer from potential to kinetic energy requires work, in this case, cognitive work: the kind that results in firing signals or "spikes." Consider the work a word requires. Word. Spike. Consider the work two words require. Word, word. Spike, spike. Now three. Now four. Now sixty thousand. A spike train is, according to neuroscientist Devika Garg, a "combinatorial sequence of spikes and silences"—a kind of binary code in which the zeros represent the latency period between stimulus onset and response.

Imagine reading *Wake* word by weird word in sequence like a slow-drip IV. Watch as the words, their wild semantic potentials, cause ERPs. Aggregate and analyze the massive data stream.

Literary scholar Franco Moretti, sometimes referred to as the Linnaeus of literary theory (elsewhere Galileo or Darwin), has proposed a strategy known as "distant reading." *The New York Times* provocatively summarizes Moretti's scholarship like this: "To understand literature . . . we must stop reading books." His hypothesis-testing, computational modeling, and quantitative analysis supplants the human perceiver of literature. Think concordances and word clouds, vectors, and plot diagrams. In Moretti's world, the "protagonist" is "the character [who minimizes] the sum of the distances to all other vertices." It can be intuited—along with antagonist, genre, subplot, theme, you name it—from grammatical and semantic signals (yes, words) alone. *The New York Times* again:

> People recognize, say, Gothic literature based on castles, revenants, brooding atmospheres, and the greater frequency of words like "tremble" and "ruin." Computers recognize Gothic literature based on the greater frequency of words like . . . "the."

But a regimen of distant reading cannot terminate the author's relationship with her first reader: herself.

Rikki Ducornet, whom I've often called the best word-for-word sentence writer in the world (to borrow from the parlance of boxing), says: "Writing *is* reading and reading a way back to the initial impulse." A Ducornet sentence is often visual and discursive, set off by em dashes, parentheticals, commas, italics, capitonyms; each small choice is a bonfire of meaning. My favorite sentence in *The Deep Zoo* goes like this: "In other words, to write in the light of childhood's burning alcohol, with the irresistible ink of tigers and the cautious uncaging of our own Deep Zoo, we need to be attentive and fearless—above all very curious—and all at the same time."

At bedtime, my son's nursery feels more like linguistics lab. With just one simple or compound sentence per page, a children's book follows the experimental control rules of the EEG lab. Words like "room," "telephone," "balloon," "cow," "moon," "bears," "chairs," "kittens," "mittens," "mush," and "hush" all conspire to mean something to my son. I imagine them the way they must mean to my son, all mashed up—"In the great green balloon, there was a bear and a red cow and a picture of mush jumping over the telephone."—until suddenly they're not. Each page is a "Gauww?" waiting to happen. It's his own way of saying, "Wait, what?" It's the N400 as bedtime ritual.

Don't read books, just their words. To comprehend our electric-creative potential, we must be willing to encounter words in a singular way—as they lie in the rented space of the sentence, begging their way into our blinking brains.

explore in full here, but one thing it will help to shine a light on is that this firing/swapping occurs at the synapse: a microscopic bit of space between the axon and dendrite. Which is to say: signals leap. Such leaps—as you read this, as you take in passing audio information, as you breathe, blink, fart, and daydream—are continually happening across all the brain's parts.

So, what does a mind at work look like? It's all quickness and light.

* * *

If I give you a list of people to remember and a woman named Baker is on the list, you're less likely to remember her later than you would a woman who *is* a baker. The reason behind this is harsh: language barely signifies. Baker, the name, fires neurons associated with naming and language. That's it. But baker, the occupation, fires not only language neurons but those associated with smell, food, memories set in bakeries, and so on. Anything encoded semantically—that is in terms of its significance and meaning—will have a better chance of making it to long-term memory storage than things encoded only visually or acoustically.

It's called the *Baker-baker* paradox and it shows us a way to write better: encode your stuff semantically. Generate layers of associative meaning. My favorite example of this comes from the "Findings" column in *Harper's*—the magazine's back-of-the-book assemblage of the month's findings from the scientific community. In essence, it's a prose poem built out of facts, but these facts are always re-engineered to convey both information *and* emotion. Once, I sat down to talk with its author, Rafil Kroll-Zaidi, about his process. He pointed me to a certain finding from years before we met:

A cat gave birth to a dog in Brazil.

"First problem with that," he told me, "is what's interesting is that a cat gave birth to a dog. 'In Brazil' is just dead language sitting at the end of the sentence. You don't care about it by the time it happens." He suggested a revision:

In Brazil, a cat gave birth to a dog.

"So you've got the kicker at the end," he said. Then he gave me a funny look. "Or. . .? Better. . .? Can you guess?"

I couldn't guess. I waited for him to tell me.

A Brazilian cat gave birth to a dog.

Brazilian shifts from adverbial information to an adjective, he explained, and

when that happens, something goes queer about the sentence. The sentence is already confusing: A cat shouldn't have given birth to a dog. Kroll-Zaidi delivers the finding in such a way to amplify that confusion, thus making it far more memorable and affecting than, say, "According to a 2006 Reuters report, a woman claimed 'her cat Mimi had given birth to . . . three puppies as well as three kittens.'" (Whether you're OK with overlooking the additional two dogs is another essay for another time.)

Here, on the page, was the quickness and light I saw going on in the brain, those rapid associations engineered through language. Kroll-Zaidi is looking to build layers of affect: information and mood, punful disturbances. It's a lot like what makes Julie Smith, David Foster Wallace's protagonist in the short story "Little Expressionless Animals," so good at *Jeopardy!* Smith spends much of her childhood reading and consolidating to her long-term memory "an obscure and limited-edition Canadian encyclopedia called *LaPlace's Guide to Total Data*," which we're meant to believe is one reason she becomes the first-ever *Jeopardy!* contestant to stay on as champion for more than the regulated five-day run. (The story is from the 1980s, long before the rule changed, allowing for serial winner Ken Jennings et al.) Smith wins 740 games in a row. One other reason for her success is more occult. "This girl not only kicks facts in the ass," is how one character puts it. "This girl informs trivia with import. She makes it human, something with the power to emote, evoke, induce, cathart."

There it is again: *induce*. Semantic encoding gives us the power to induce an experience in the reader.

* * *

About ten years ago—to give you a sense of how new these findings are—Robert Bjork, a cognitive scientist at UCLA, ran an experiment on learning. He set up two classes of students, all of whom had to learn about the work of twelve artists. The students in Class A "block sorted" the work, studying six different paintings by one artist before moving onto the next. In Class B, they "interleaved" the work, studying one painting by one artist at a time and cycling through the twelve artists in six rounds. All students saw the same seventy-two paintings. Then Bjork tested both classes by asking them to identify which of the twelve artists created a painting they hadn't seen before.

Guess which class did a better job on the test.

Class B, with the interleaved study, did a better job. Findings like this led Bjork to coin the term "desirable difficulties": conditions that appear to

impede performance during training but which actually lead to better long-term retention and retrieval of the material. Researchers found all sorts of other such "difficulties." My favorite example is the study in which one class studied materials on a fictional animal printed in good old, boring Arial font and the other class studied the same materials printed in **Comic Sans MS** at 60% grayscale. Again, class B did better on tests.

Does this mean essayists should submit our manuscripts printed in Comic Sans? You're welcome to try. I won't, but as a writer I'm interested in this notion of creating desirable difficulties, and more specifically in interleaving. Interleaving looks a lot like what we in the nonfiction community call a "braided essay," in which two or more topics are woven together to form an essay's throughline. (John McPhee's "The Search for Marvin Gardens" and Jo Ann Beard's "Coyotes" are good examples.) Bjork's findings suggest the braided essay might be more than just a nice way to shape a piece; the structure might actually help a reader engage more deeply with an essay and retain more information from it.

And it's nice to think of difficulty as being desirable. So often, in my first drafts I worry over what readers will understand or how much they'll follow me on a line of thought. Or I'll get a wild idea to leap from beer cans, say, to the shoes of Imelda Marcos, and I'll worry that readers won't follow me there.

But readers will follow you there, and they'll be happier for making the jump. More than "show don't tell," the phrase I repeat *ad nauseam* in my classrooms is "leap don't creep." Make wild associations and connections without worrying about spelling everything out. Joy Castro, one of the finest memoirists I know, told me recently always to assume my reader is smarter than I am. "Leap don't creep" is not only a reminder to write up to such readers, giving them desirable difficulties to engage with, but it also makes me write in a way that mirrors the working of their active, brilliant minds.

* * *

The brain is a master class on how to write nonfiction. The better we understand its processes and its landscape, the more artful our writing can be. It's like sending fiction students out in the world to capture the way light falls on a tree or to eavesdrop on conversations so as to understand dialogue. When you write to build a world, go out into the world. But when you write to induce a mind to think, why not go, *Poseidon Adventure*-like, into the mind?

5

Brain on Fire

Nicole Walker

My father grew up on Dearborn Street, in Salt Lake City, Utah, but after his dad died, his mom moved to McClelland Street. In my memory, I conflated Dearborn the Street with Dearborn the town in Detroit and imagined my dad sitting on the stoop of a brownstone playing kick the can down the center of his Detroit-centric home. On McClelland, my grandmother gave us big wooden, brick-colored blocks to play on the carpet with our cousins while she fed us apples sprinkled with salt. I fell off my tricycle while riding around the block around her street. She fell down the stairs while babysitting me in her McClelland house after drinking too much and had to move to a one-story condo. Or, at least that's the connection I made. My dad wasn't big on nostalgia and in so not telling us stories, the stories slip in. In my mind, my dad had deep city roots. The sound of Grandma's ribs hitting stairs is a crack—a shebang, a lightning bolt. It keeps all the brick, brownstone images together. Now, if I write a story about my grandmother or my father, it goes brown, stone, brick, crack.

This may be a way to consider how we make essays that generate emotional and empathetic response. Argument and narrative are great for hooking people into an essay, but how do we make it resonate within the reader beyond intellectual understanding? When we teach creative writing, we ask our students to be specific, to include idiosyncratic detail. We know we like to read details, we know it makes the writing more mimetic to life, but we also understand, subconsciously, that the details make something bigger than the sum of the parts and that the details exist to create visceral opportunities for emotional and empathetic connection.

My husband, Erik, spent his elementary school years on 14th Street but then his family moved to Wellington, which is just down the street from the same Dearborn Street my dad grew up on. For the first time in my life,

because I was dating my future husband, I drove by that street. Erik pointed out to me the elementary school on Dearborn. My mother told me—she who would rather fill in the gaps than leave it to my collection of misremembered memories—that my aunt was impregnated by the janitor of that elementary school. I click through the names in my memory: Greg, no that's whom my cousin married when she was seventeen. Jimmy, no that's my aunt's second husband. Randy? There were two Randys. The first was my aunt's hippy boyfriend who drove a Trans Am and who took us to a hotel room at Snowbird Ski Area with a gas fireplace. I put my doll too close to the fire. Her hair melted to the back of her head. The other Randy was a real asshole who married my other aunt and took all her money. What was the janitor's name? My grandma, my dad's mom, like my dad himself, wouldn't speak it so now the idea of him just tumbles into the gap, and I picture the janitor with a mop and a mustache and my aunt's bulbous belly, carrying my cousin in her body. My cousin is only six months younger than I even though my dad was eight years older than my aunts. We played with grandma's wooden blocks together. We built whole brownstones out of them.

Functional MRIs have lately been able to show how visual images make an impact on the brain. As a writer, I want to know how many triggers I can pull using images, word choice, and metaphors to make the associations across the brain chime together in the way they do for me: brick to janitor to mop to brick. When I write nonfiction, I think of things like argument, memory, and story, but what I rely on, since I usually talk myself out of my argument, since my memory is a steel sieve, since story reads like interrupted anecdote, is image. I use image like a leitmotif that supposedly holds the story together. But does it? Do the triggering images trigger the associations I mean them to in the reader?

When my boyfriend Alex punched me in the jaw after he'd moved back into the house on Cora, he didn't mean it. He was drunk. I probably was drunk too. I don't remember exactly why he hit me. I was nagging or complaining or aggravating. This is not a domestic violence narrative. I bring it up only because it's the only time I remember being hit or even seeing anyone hit. My nose wasn't bloodied. I had lockjaw anyway. I do not begrudge him for this at all. What I begrudge him for is the weight I lost and then gained back after he broke up with me days/weeks/months after our fight. The white dress, size 3, I could wear for those months we were broken up and I was antagonizing him by coming to his apartment where the walls were painted a whiter white than my dress and we listened to so much Paul Simon that I still sing the lyrics "take this child far to Tucson Arizona, give

across the brain. Princeton researchers used functional MRIs to discover how the brain understands words differently than pictures. Head researcher Matthew Botvinick says, "The thought is that there are many things that can be expressed with language that are more difficult to capture in a picture. Our study dealt with concrete objects, things that are easy to put into a picture, but even then there was an interesting difference between generating a picture of a chair and generating a list of words that a person associates with 'chair.'" Botvinick and his fellow researcher, Francisco Pereira, asked study participants to visualize words as they were presented to them. By using categorizing types of words, the researchers could, using functional MRIs, trace the areas of the brain that lit up. They were able to see that words like "chair," "table," "dresser," and "bed" all as one category: "At the same time, the team established all the words associated with 'furniture' by matching each fMRI image with related words from the Wikipedia-based list." But words like "chair" don't stick in one category like a graphic of a chair might. "Someone will start thinking of a chair and their mind wanders to the chair of a corporation then to Chairman Mao—you'd be surprised," Pereira said. "The brain tends to drift, with multiple processes taking place at the same time. If a person thinks about a table, then a lot of related words will come to mind, too. And we thought that if we want to understand what is in a person's mind when they think about anything concrete, we can follow those words."[3] Words have the capacity to drift. Homonyms, homophones, graphemes, and words as images stimulate areas across the brain, creating surprising connections.

Sucking up words as grapheme and words as signifier, the brain then categorizes. But just because the brain likes to categorize, it doesn't mean a word or a word-image has to be organized to only one category. Complex ideas expressed in language can light up several regions of the brain at once. We can trace this brain activity as the word "bed" might light up areas associated with "furniture" and "sex" and "sleep." As we write, then repeat certain images, put them in certain categories, we trace and retrace, making patterns. Our stories become a complicated light song.

I think of the communication between the aliens and the humans in *Close Encounters of the Third Kind*. I think of the brown bricks in my grandmother's closet in Salt Lake City that I would pull out and immediately be transported to another place—a category of Dearborn, Detroit, and brownstone that exists only in a real place in my mind. I put on an off-white dress and remember that one bite of hamburger at McMenamins and how desperately I wanted that moment to last forever—boyfriend coming back to me, thanks to my thin body and my off-white dress. He would let me into his white

apartment now.

As we write, we may not know exactly what categories we trigger in our reader's brains but perhaps, like the light and music display in *Close Encounters*, by repeating different words, brownstone, Dearborn, janitor, perhaps we create our own category, pulling together an ever-tightening ball of "this particular story." Perhaps we pull connections across categories, making new associations possible through repetition, image, metaphor, and leitmotifs. Ian Sample, science editor for *The Guardian*, reports that "scientists have created an 'atlas of the brain' that reveals how the meanings of words are arranged across different regions of the organ."

"Like a colourful quilt laid over the cortex, the atlas displays in rainbow hues how individual words and the concepts they convey can be grouped together in clumps of white matter." Sample writes,

> No single brain region holds one word or concept. A single brain spot is associated with a number of related words. And each single word lights up many different brain spots. Together they make up networks that represent the meanings of each word we use: life and love; death and taxes; clouds, Florida and bra. All light up their own networks.[4]

Researchers Jack Gallant and Alexander Huth, using stories from the Moth Radio Hour, a public radio program featuring short, dramatic nonfiction pieces, recorded the subjects' brain activity as they performed their stories. Gallant and Huth discovered that there are, at least for these subjects, defined semantic pathways that show how specific words stimulate brain activity.

> The atlas shows how words and related terms exercise the same regions of the brain. For example, on the left-hand side of the brain, above the ear, is one of the tiny regions that represents the word "victim." The same region responds to "killed," "convicted," "murdered" and "confessed." On the brain's right-hand side, near the top of the head, is one of the brain spots activated by family terms: "wife," "husband," "children," "parents."[5]

Across this atlas of brain activity, the word-images spark. The synapses ignite over here and then over there, the brain lights up. Isn't the writer's dream to turn the whole brain on fire?

In quantum physics, although I can't think of a billiard ball metaphorical equivalence, there's a theory called quantum entanglement that provides a good metaphor for how we can get multiple networks in the brain lit up simultaneously. "Quantum entanglement is a quantum mechanical phenomenon in which the quantum states of two or more objects have to be described with reference to each other, even though the individual objects

may be spatially separated."[6] If you get one particle spinning in one network, its twin particle spins in another region. Think of a word-image, like bed, which might light up the "furniture" network as well as the "parent" network. By repeating the words "bed," "furniture," and "parent," you can make these different regions of the network glow. Then, by making that pattern, you can make the "furniture" a nostalgic, nurturing space as well as a place you put your quilt.

The Princeton study referenced above reaffirms this pattern making. Those word associations, lead author Pereira explained, can be thought of as "semantic threads" that can lead people to think of objects and concepts far from the original subject matter yet strangely related. "Someone will start thinking of a chair and their mind wanders to the chair of a corporation then to Chairman Mao—you'd be surprised," Pereira said. "The brain tends to drift, with multiple processes taking place at the same time. If a person thinks about a table, then a lot of related words will come to mind, too. And we thought that if we want to understand what is in a person's mind when they think about anything concrete, we can follow those words." These collections of images create new ways of thinking and new ways of showing how thought works. Now to stitch the images back together by returning to the quantum physics billiards metaphor: If we think of images as a cue ball and a pool stick and the brain is a billiard table covered in balls, pull back on the cue stick, write about the color white on the walls, the white of the dress, the whiteness of the boyfriend's face you forgot to mention, and then jam that stick ahead. Am I a good pool player or a crappy one? Did I hit the cue ball, make it roll to the right, make it bounce in the center of the solid blue which rolled into the center pocket while striking the solid green and making it roll into the left hole? Or am I a crappy writer and scratch the cue ball? Is this what I want from my narrative anyway? You can play different kinds of pool: Nine Ball, Eight Ball, One Pocket, Cutthroat, or 14.1 Continuous. All are played on a large, carpeted table with four corner and two side pockets, up to fifteen numbered and colored billiard balls, a cue stick and a cue ball. The object is to pocket a certain group of balls, sometimes in a particular order.

There isn't one way to write an essay. There isn't only one trajectory we must follow. But like billiards where players pocket a certain group of balls, writers group a certain collection of words. By paying particular attention to those words, by repeating them and making metaphors of them, we create a world of images, an image set, that houses our stories and allows them to cohere beyond the more common understanding of coherence. Through word-image gathering, the writing hangs together not through

narrative or argument or other kinds of rhetoric but through synergies of brain activity stimulated by recurrent word use.

How do we hold essays together? How do we hold anything together? As, we, for example, scroll through Facebook, horrified at the recursive images of the latest school shooting, we search for answers. Facebook makes leitmotifs of the world, showing the same twenty video images posted by a thousand different friends over and over again. We see nothing but videos of this horrible tragedy, taking place in this horrible country, plagued by horribly indifferent adults allowing their kids to be shot with horrible weapons. But then we read some statistics that show that even though school shootings are terrible, in terms of real deaths by guns, suicide is a much more pervasive tragedy. But you can't show pictures of suicides. When Anthony Bourdain kills himself a few months after the shootings at Marjory-Douglas, Bourdain quotations and still pictures of him fill the Facebook pages all over again—a different leitmotif, a different reaction. The collection of videos produces action from the Parkland students and calls to congresspeople. The Bourdain suicide led to personal reflection—why did we love him so? Why did someone so successful feel like death was the only solution? We post our phone numbers and invite the potentially suicidal to call.

What I'm looking for is not just one hit that creates a cascade of associations. Like social media, I want those associations to make a pattern. I can't just expect one cue ball to do all the work. I can't expect my reader's brain's billiard balls to be lined up just right. And I am a crappy pool player. I'm thinking something more scattershot might make a better metaphor. But I'm not into pheasant hunting either. What am I good at?

My aunts were good at boyfriends. I wanted to be good at boyfriends. My aunts took me and my sisters to Wild Wave Waterpark and Lagoon. They were the young aunts and the fun ones but for some reason, they churned through a lot of guys. Because my parents were still married and we were from Utah and though not LDS anymore, the prevailing wisdom about marriage was that marriage was a good thing. My aunt Brooke, although married often, became my hero. She was the first one in our family to get her PhD. The first one to divorce her third husband, after he bailed on her, and go it alone for a while. She moved to Denver, which is like Detroit in that it starts with the letter D and there are bricks there and elementary schools and factories. At some point though, those images became part of her past, an essay that existed before she stopped looking for jerky boyfriends. Now, in Denv er, she gathers different pools of images: Cherry Creek, 14th Street, The University of Colorado, at Boulder, train track,

columbine. A new essay made out of new images that include no one named Randy and nothing brown or white at all.

writers and all your feelings."

In the last year, I've lost two people, whose faces I keep seeing when my eyes are shut. Especially when my eyes are shut. They come to me when my eyes are open, too. But the visual cues of the world bring me back.

Sometimes.

Sometimes I stay with those faces. Sometimes those faces talk to me, but I can't hear them. Their lips move. They smile. They laugh but emit no sound of laughter. I am left wondering what are they trying to communicate. Or whether they are simply telling me a story I can no longer hear.

* * *

I used to like story. I craved it. Wanted it. I needed to know what happened next. Now, my mind skips like a flat rock on a pond.

* * *

As I've gotten older, I don't think I believe in stories anymore. What I believe in is the silence after a story is told. That satisfaction. Like the sigh after a swig of soda.

* * *

When I was a kid one of my favorite movies was *The Man with Two Brains*, a 1983 comedy that stars Steve Martin, as Dr. Hfuhruhurr, a neurosurgeon. The movie is filled with slapstick, nonsensical moments, a reason why the child me loved the narrative. The child me waited for the next crazy situation, the next silly thing. The child me loved physical action and reaction, like the zany sobriety test police officers make Hfuhruhurr take.

Now, I watch the movie and think, here is a man in love with a brain and not the body. Here is a man who would murder a body for the love of a brain. And suddenly, I spiral into abstraction.

* * *

I know it's me that sees the brain as this ugly gelatinous mass. In the movie, Dr. Hfuhruhurr displays a child-like joy being surrounded by jars of brains. It is as if he is in a prairie of wildflowers.

My son is nearing two. His brain, this sponge, is ever in wonder. It absorbs language. It commands the body and all its recklessness. Everything is new. My son's brain, right now, is in the constant state of learning.

No.

Living.

Dr. Barnett, author of *Idiot Brain*, says, "The beautiful thing about a toddler's brain is everything exists in the gray matter." Uncertainty rules. It's not until children reach their teens that they begin to lose memory. And memory, this planet of fog, suddenly becomes a type of certainty, the thing that shapes our living.

* * *

My mother's brain, at 82, is falling quicker into the gaps. I tell her things and she forgets them. When I overhear her talking to her friend in Chicago, the conversation loops in on itself. My mother is old. Her friend is old. Their brains are old. *How old is your grandson? Wait, Sue died? You have a grandson? How's Sue? How old? Tell Sue I said hi.* It is hard for me to negotiate this change in my mother, who had been sharp and attentive and ever-present throughout my life. She still is. But now I repeat myself. My impatience creeps up on me. My impatience can be venomous and unforgiving. *I already told you, Mom. Remember? Why can't you keep this in your head? I've said this again and again. You are killing me.* My mother absorbs this.

Until she can't.

Until she says to me, *You won't have to deal with this for much longer. I will be gone soon.* Guilt then quiets my rage, forces my head down, forms a deep sigh that is an unsaid apology.

* * *

My brain has begun to stall, like my mother's. My brain, this control center of every action, is aging, is aged. It is spending more time within itself. Less time experiencing the textural world. It is like an old hermit. He comes out and the sun is so bright it chases him back in. My brain is in a constant state of losing. It's losing by the second. And in that loss, sometimes, a gap forms and I fall in. I will keep falling.

I like taking internet quizzes that tell me whether I'm a right-brained or left-brained individual. The questions put you in what-if situations. Like: Your boss gives you a shit ton of work to complete by next week. How do you go about accomplishing this task? (a) You jump from one task to the other until all is done. (b) You put them in a list of importance and complete each task one by one. (c) You organize them by importance and work on one until you get bored then move to the next.

There are no questions on the tests that ask why I'm taking the test. I do

it in many ways to confirm my life decision to be an artist. To prove that my choice to live in a world of creativity instead of logic and certainty was the right one.

Because sometimes I doubt.

Because, honestly, I like math. I like numbers. I'm good at them. Always have been. You are looking at Harnew Elementary's Math Champ Master from second to fifth grade. I crave organization and structure. It might be the reason why the results of all the internet quizzes I've taken suggest that my left and right brain are in perfect balance.

* * *

The real reason I take these quizzes: I'm procrastinating from doing any work, especially writing about the spaces in the brain.

* * *

In sixth grade, when I was dethroned as Math Champ Master, I read book after book after book. I wanted to be with words more than numbers.

* * *

Quiz: When you open the refrigerator and forget what you wanted to get out, you _____:

(a) stand there in the cold chill, trying to recall what it was you were looking for.
(b) close the fridge and curse endlessly about how much your aging brain sucks.
(c) grab a pint of ice cream and say *fuck it*.

Now I think about the space that separates the halves. I think about the meaning of the story, rather than the story. The story is a closed fist. The meaning of the story is the moment the fist opens.

It is something I'm dealing with. I know not everyone feels the same.

A friend of mine, a fiction writer, says, "Stories give him sense in a world of senselessness." We follow a character as they evolve. By the end, time has made that character different. "Time matters," my friend says, "because time evolves us."

I don't disagree.

Another friend says, "She distrusts plot. She hates the word plot when

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