Designed as Designer

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Abstract

Conceptual integrity arises not (simply) from one mind
or from a small number of agreeing resonant minds, but
from sometimes hidden co-authors and the thing designed
itself.

Categories and Subject Descriptors A.0 [General]

General Terms Design

Keywords Conceptual integrity, design

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Morning floods Firenze—the sun stains roofs, heat and
smoke clog the sky in red. Noise starts at dawn or just be-
fore; the smell never stops.

Pippo is long up, and before his mother begins cooking
he's halfway to the build site where he sees bricklayers, cart-
ers, and leadbeaters already gathering, carrying their tools
and leather bags of rough meals. Coals are being fluffed
to blacksmoke fires and then burning hell for the black-
smith's forge and another day of repairing tools. Stealthy
cooks steal the blacksmith's flames with tapers to start their
cookstoves to feed the craftsmen throughout the looming
midsummer's day.

Pippo joins a parade of oxcarts bearing bags of sand and
lime, and next to him a merchant lugs a wicker rucksack
of wine on his back. Pippo's urge is to watch the treadmill
hoists and cranes lift their first loads of the day to the top
of the nave. The great cathedral of Firenze.

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*The central problem…is to get conceptual integrity
in the design itself…*

…Fred Brooks told us in his sweet southern voice—Mon-
tréal, OOPSLA 2007, during his keynote [1]. I recalled a

comment I heard at Bread Loaf back in the '90s, after Larry
Brown read—the late fiction writer from Oxford, Mississip-
pi—that anything sounds 10 times more true when spoken
by someone with a southern accent. As Brooks spoke—
mostly off the cuff—and paced slowly away from the podium
and back, I fell under his spell—as I suppose did most of his
audience. He went on:

> *If we look back then at the 19th century and the
> things that happened—the cartwright and the tex-
> tile machinery, Stephenson (the train), Brunel's
> bridges and railway, Edison , Ford, the Wright broth-
> ers, etc—these were very largely the designs of sin-
> gle designers or, in the case of the Wright brothers,
> pairs.* [1]

Read that paragraph aloud and you'll hear the rhythm of
his speaking. I wanted very much to believe every word he
said—he's Fred Brooks after all. —*The Mythical Man Month.*
—OS/360. And why not?—nothing sounds off, and it's certain
he's done his homework. I'll quote him at length now:

> *Now if we look back at the history of human pro-
> duction and culture, most works of art have not been
> made [by teams]. And that's true whether we look at
> literature, whether we look at music—although we
> have Gilbert and Sullivan; notice that one did the
> words and one did the music—Brunelleschi's dome,
> Michelangelo's tremendous works, the paintings—
> there are some paintings by two painters; one did
> the creatures and one did the landscape kinda thing,
> this careful division of labor—and the exceptions
> to the notion that most of the great works we know
> of were done by one mind are in fact done by two
> minds and not by teams.* [1]

Fred Brooks imagines an ideal when he thinks of design:
conceptual integrity arising from a single mind creating
a design. Brooks once wrote "conceptual integrity is the
most important consideration in system design," [2] and
by conceptual integrity he means "one set of design ideas."
"Every part must reflect the same philosophies and the same

balancing of desiderata" [2]. "Conceptual integrity...dictates that the design must proceed from one mind, or from a small number of agreeing resonant minds" [2].

> *...modern scholars now recognize that the works of Homer...are...the works of one mind....[T]he important poem Beowulf is...a literary work...of one mind.*
>
> *As I say the exceptions are two, and two is a magic number. There are many, many jobs in the world that are designed for two people: the carpenter and the carpenter's helper, the electrician and the electrician's helper. And I think our Lord knew what He was doing when He made marriage work for two.*
>
> *But now let's look at some of these magnificent works.*
>
> *Brunelleschi's dome—and many of you have read the book—was a tremendous creation, technically beyond what people believed possible. He had to produce a working scale model before the people buying the project would even believe that it could be built. And notice the scale of this building in comparison with the surrounding buildings.* [1]

Fred Brooks went on to speak of why we need to design in teams. He gave three reasons: the first is that engineering is now sufficiently sophisticated that specialists are required to create the designs. The third is that many hands make light work—that is, it helps to break up an enormous task into smaller ones that are more readily achieved. Here is how he phrased the second reason:

> *Now, the second major reason why we do things in teams is hurry to get to market. We all know the rule that the first person to market with a totally new innovation tends to stabilize out with 40 or 45 percent of the share, and the rest is divided up among the come latelys.* [1]

When Brooks said this it tweaked a memory from the days when I was creating arguments for and against a "theory" I whimsically proposed in 1991, now known as "worse is better." That theory argues that the best and most enduring products—and their designs—arise from producing an adequate design and implementation, and then making it available and putting it to use so its users have an opportunity to contribute to its future refinement. In short it's a way to learn the real requirements before it's too late.

While working out the arguments, I became interested in the arc from conception to usage for all sorts of things—software, consumer goods, and even works of art. While exploring this I stumbled across the work of Gerard J. Tellis and Peter N. Golder, two business researchers who concluded that the dictum *first to market* is really a myth [3].

—A myth created by poor research methodology and imprecise definitions.

First the shocking truth: looking at 66 categories of businesses, Tellis and Golder found that the mean market share of the pioneer companies is 6% (as of the year 2000). Of the 36 categories where the pioneer entered their market before 1940, the market share is 6%; for categories first entered between 1940 and 1974, it is 10%; and after 1974 it is 4%. This is a long way off from 40 to 45 percent.

Now the reasons. Studies before Tellis and Golder made 3 fatal errors. First, even when they tried to be objective, investigators usually ignored pioneers who failed completely or left the market. For example, many consider Gillette the pioneer in safety razors, but in fact Gillette is merely the oldest surviving player in that market. The safety razor had been patented and was sold by several companies decades before Gillette was founded, and an early design for the safety razor had been created a century before Gillette came on the scene.

Second, many studies suffer from self-report bias. Investigators in such studies survey companies currently in the market and rely on those companies telling the researchers who the pioneers are/were. Procter & Gamble, for example, claims to be the disposable diaper pioneer: P&G reports it "literally created the disposable diaper business in the U.S." [4]. Yet, for decades before Pampers came along, other companies sold disposable diapers: the pioneer was a company called Chux, which introduced disposables in 1934. Pampers entered the market in 1961.

Third, there are definitional problems with some surveys trying to determine first-to-market advantage. For example, Wang dominated the word processor market for a long time, where a "word processor" was defined as a "dedicated word processing machine." Another is to define as pioneer as a company that entered a market early in its history. This is why Gillette is considered a pioneer in the safety razor business.

Brooks's statement also seemed odd because I knew that he knows about this effect. In the 20th anniversary edition of *The Mythical Man-Month*, he wrote:

> *One of the most impressive developments in software during the past two decades has been the triumph of the Windows, Icons, Menus, Pointing interface.... This concept was first publicly displayed by Doug Engelbart and his team from the Stanford Research Institute at the Western Joint Computer Conference of 1968. From there the ideas went to Xerox Palo Alto Research Center, where they emerged in the Alto personal workstation, developed by Bob Taylor and team. They were picked up by Steve Jobs for the Apple Lisa, a computer too slow to carry its exciting ease-of-use concepts. These concepts Jobs then embodied in the commercially success-*

ful Apple Macintosh in 1985. They were later adopted in Microsoft Windows for the IBM PC and compatibles. [2]

Of course, this history ignores Sketchpad [5] and possibly even earlier ideas, as well as contemporaries of the Alto like the MIT Lisp Machine.

But getting back to Brooks's talk: the seed was planted—the seed of doubt. Maybe Fred Brooks could be wrong. —Not wrong, really, but incomplete. —Incomplete in his scholarship or depth of analysis. Or maybe he—as many of us do—looks a little too optimistically for the real world to confirm his ideas. Or he is not wrong but *in situ* examples are too messy to be perfect. As G. B. Shaw could have said, they are *too true to be good.*

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Pippo—back home and over breakfast—asks his father to tell him again the story of the cathedral. Breakfast: his mother's prepared his favorite—salt pork fried in orange and lemon with sugar and cinnamon sprinkled over. His father tells him again—the 40th time?—about the immense and immensely beautiful design of Arnolfo di Cambio, and how they razed the old church and even another to make room, how they brought in slaves to remove the corpses from the old cemetery, how the workers stopped and the cathedral was abandoned after the sickness came, how the nave and façade stood out in the rain every winter for more than 10 years. Over the bleats of sheep and goats and clucks and honks of chickens and geese Pippo hears the shouts of orders from the work site.

But why has it taken so long, Pippo asks. It's almost 100 years and it's not half done. His father answers: We must always await the gifts from God that show us the way forward.

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My experience—writing poems, writing stories, doing photography, working on small graphics and drawing projects—is that design and art are rarely the product of a single mind. I take that back; they never are. There are two ways that the single mind idea doesn't work with art and poetry. The easy one to understand is the ways that others are constantly helping. As a writer I encounter help in all sorts of ways.

I've never published anything in a serious venue without some friend or colleague—and usually several—having read and commented on it. I take the comments seriously, and there are several friends whose recommendations I adopt essentially without question. The typical nonfiction book is full of acknowledgements that indicate a co-author-type relationship, and that's true for my writings.

And even when an artist seems to be creating something completely new—artists like da Vinci, van Gogh, or Beck-

ett—it usually turns out there are hidden, unconscious influences even they can't recognize.

One of the more well-known examples of this sort of help is the relationship between T. S. Eliot and Ezra Pound. Roughly around 1920, Eliot started work on his best-known poem and masterpiece, called *The Waste Land*. At that time both Pound and Eliot were expatriates—Eliot in England, Pound in France—who on occasion worked together, with Pound generally playing the role of mentor. Pound was a sort of talent scout, and had helped Eliot get his first poems published a few years earlier. On his way to Switzerland for a "rest cure," Eliot took his *Waste Land* manuscript of about 1000 lines to Pound in Paris for comments, and he stopped in Paris again on his trip back. There were undoubtedly many conversations, but also there are marked up manuscripts in the Berg Collection in the New York Public Library that tell us the story of the collaboration.

Pound found the heart of Eliot's manuscript and directed him in paring it down to the 434 lines we see today. Don't be fooled: Pound did not merely scrape away words, lines, and stanzas (though that's what he mostly did); Pound's comments are extensive—if cryptic to readers not accustomed to artists talking to each other—and not particularly subtle. He pointed out weaknesses and suggested changes. Eliot wrote this about the role Pound played in *The Waste Land*:

> *It was in 1922 that I placed before him in Paris the manuscript of a sprawling, chaotic poem called* The Waste Land *which left his hands, reduced to about half its size, in the form in which it appears in print. I should like to think that the manuscript, with the suppressed passages, had disappeared irrecoverably: yet on the other hand, I should wish the blue penciling on it to be preserved as irrefutable evidence of Pound's critical genius.*
>
> –T. S. Eliot, *Erza Pound* [6]

A hypothetical programming language example with lots of deletions and some revision to think about: suppose, in a world with nothing like Lisps, someone designing a programming language came up with essentially a messy version of what we would call Common Lisp. The Pound for this Eliot might well identify a subset of the language which, when cleaned up and revised a bit, would turn out to be what we would call Scheme. Common Lisp is very large, even rambling, and Scheme is small and elegant; the major fundamental difference between them is that Common Lisp has separate namespaces for functions and values while Scheme has a single namespace. A particular subset of Common Lisp is not far off at all from Scheme—the revisions to make it Scheme would encompass only some small syntactic changes, the namespace collapsing, and the addition of continuations. Suppose our software Eliot made those revisions on the advice of our software Pound: would

this Eliot be the genius who came up with the masterpiece known in our world as Scheme? —Be the sole author of its conceptual integrity?

Collaboration of authorship is not always or mostly about pruning. Richard Woodhouse played a similar but less extensive role for his friend, John Keats. In several important poems, the revised wording of lines come either after suggestions by Woodhouse or using the words Woodhouse proposed [7].

Copyeditors can make substantial contributions to a manuscript. Changes beyond grammar are not uncommon. Such changes were made to some of the most important Keats poems by his publisher, John Taylor, including in response to directions from Keats to Taylor, which Woodhouse reported as follows:

> ...accept which [readings] they pleased, & ... revise the Whole. [6]

Other poets practice what could be called "creative plagiarism." Samuel Taylor Coleridge seems sometimes to have taken another poet's poem as a very detailed starting point for his own. It is well researched that some of the material in his most famous prose piece, *Biographia Literaria*, was a composite of several passages taken from Leibniz [7].

Technical books almost always go out to reviewers who occasionally propose major changes. In the past I've proposed to book authors radical organizational and even thematic revisions that were adopted. I've also reviewed drafts of novels and poetry manuscripts where my substantial changes have been adopted, sometimes word for word.

Many writers even in technical fields use writers' workshops to improve their manuscripts. Some published pieces have been workshopped many times. In a writers' workshop, a more-or-less formal process is used to go deeply into a manuscript in such a way that the writer is inclined to listen carefully to the suggestions, and the final—sometimes crucial—step of the process produces concrete suggestions for improvement. It's not uncommon for a member of a workshop to offer detailed wording, structural, and even fundamental what-is-this-piece-about suggestions.

⤙

Pippo drinks his milk and wonders how anyone but God could design such a large and most beautiful cathedral.

Arnolfo was a great man, a great mason, his father says. He and the other masons knew how to build great buildings. Arnolfo created a model that all who came after followed and this model was the design of the cathedral. It's said that model had a great dome so that the cathedral would be more grand than any other ever built, in order to honor God and Firenze. But the model crumbled away during the sickness. Before you were born, the *capomaestro* started a new model for the dome, but the guild of wool merchants was

not certain and asked Neri di Fioravanti to build a second, and they would choose. This was wise because Giovanni di Lapo Ghini, the *capomaestro,* built an abomination to God and Firenze—a great beast such as are the churches to the north. Ugly buttresses held up the dome; they are makeshifts and the tools of the weak mind. Neri's dome—a great octagon with a perfect *quinto acuto* arch—was said to be like Arnolfo's model, but who am I to say? Neri's design was chosen and its model is the one all *capomaestri* since then have sworn and all who come after must swear to follow. All the citizens of Firenze voted, even I. Perhaps you'll live to see it built; perhaps by some miracle revealed in Firenze by God, a great man will come to know how to build the dome, and you will see the cathedral consecrated, my son, Filippo Brunelleschi.

⤙

When I sit down to write a poem, which I do every day, it's true I work alone, but I don't work in isolation. The materials I use for my work come from centuries of other writers and artists. The wall of poetry in my library contains about a thousand books, most of which I've read and all of which I've dipped into extensively. Frequently when I write, I have several of these books open in front of me, or other work open in a web browser or some other contraption. I use other poems as *triggers*, I take other poems and write them myself, I argue with other writers and poets, I run their poems through (bad) automated translators and other software to get starting points, I google to seek out strange results pages and write starting from them (a new poetic form called *flarf*). These are forms of internet age bricolage, collage, pastiche, and oulipo (OUvroir de LIttérature POtentielle or workshop of potential literature), where literature is created from what happens to be around using cut-and-paste, hodge-podge, and various (usually artificial) constraints or automatic transformations.

More than that, I write within a tradition of poetry and as part of a western, 21st century culture. I rarely invent words and I almost as rarely make up grammar. I rely on the words in my pieces to conjure specific references in readers' minds, I expect them to look up the words they don't know in dictionaries. I expect them to know or be able to figure out, if they like, the cultural or media references I use. I expect them to know when I'm writing a sonnet and to have read lots of them. I am alone, not isolated.

Triggers play today the role that God and the muses did in the past. Artists and what we would today call engineers await a revelation or spark from a mysterious source, and that spark would start and shape the process of creation. Richard Hugo, 20th century poet and teacher of poetry, wrote:

> A poem can be said to have two subjects, the initiating or triggering subject, which starts the poem

For many poets, poetry is a conversation with other poets—a dialog of themes, words, images, structures, stories, and sometimes (but rarely) meanings. One quick example.

Orpheus in Greek mythology has many functions and roles, but the top ones are being poet and musician, inventor or master of the lyre, and teaching humanity medicine, writing, and agriculture. His wife, Eurydice, was snakebit and died, and went to the underworld—and no one comes back from the underworld. Orpheus wrote and sang such sad songs the gods wept and suggested he go there to make his case. His songs melted the hearts of Hades and Persephone who agreed to let Eurydice return with him to the upper world—on one condition: that Orpheus walk in front of Eurydice and not look back—not once—until both of them made it back to the upper world. He agreed. They traveled in silence up through the passages, and when they were nearly out he had to know that she was there behind him, and so he glanced back and right at that moment she was snatched away—dying a second time. Eurydice didn't blame him and called her farewell, but the sound only almost reached him. The story goes on but this is enough.

I don't know how many Eurydice poems there are. Here are parts of two of them.

Eurydice by the poet H. D. is written from the point of view of Eurydice, who is none too pleased at Orpheus. Part II begins like this:

Here only flame upon flame
and black among the red sparks,
streaks of black and light
grown colorless

why did you turn back,
that hell should be reinhabited
of myself thus
swept into nothingness?

why did you turn back?
why did you glance back?
why did you hesitate for that moment?
why did you bend your face
caught with the flame of the upper earth,
above my face?

...

In this poem, Eurydice moves from despising the underworld and longing for the upper, to anger at Orpheus for blowing the rescue, to almost an arrogance at how her situation in the underworld is better than his in the upper because in the end she locates within herself all the earthly beauty she at first misses; moreover, the underworld must open like a red rose to let her back in.

Jorie Graham seems to like writing Eurydice poems. One is in her 1987 collection called "The End of Beauty" and another in "Swarm" from 1999. Graham is never easy to figure out (for me), but my reading of *Orpheus and Eurydice* from 1987 is this: it's a poem from Eurydice's point of view right at the point where Orpheus is about to turn back to her. She is thinking about Orpheus's about-to-happen glance, and how it will erase her, as his glance has always erased her. As he turns to glance she at first (or he at first) wants to stop the glance, and then she (he) wants to take it in. She sees the real world up ahead, but she and the real world cannot be merged by Orpheus. Here is a bit from the heart of the poem, about where it turns:

...
(Now the cypress are swaying) (Now the lake in the distance)
(Now the view-from-above, the aerial attack of do you
remember?)—

now the glance reaching her shoreline wanting only to be recalled,
now the glance reaching her shoreline wanting only to be taken in,

(somewhere the castle above the river)

(somewhere you holding this piece of paper)
...

Visits to the underworld like Orpheus's appear in the Japanese myth of Izanagi and Izanami, the Akkadian/Sumerian myth of Inanna's descent to the underworld, and the Mayan myth of Ix Chel and Itzamna. The m(yth)eme of not looking back is also found in the story of Lot's wife when escaping Sodom and in Hansel and Gretel.

Something else, though, is going on here beyond the conversation between poets. In both Eurydice poems—written at different times by very different poets—we are witnessing a known structure with different decorations, with different points of view, with different "lessons," with different aesthetics, but with an underlying—shall we call it—conceptual integrity. Not from a single mind, really, and not from "a small number of agreeing resonant minds." What is common is that the thing being created—each poem—participated in its own creation. This is the other way that the single mind idea doesn't work with art and poetry—the harder one to understand.

In these cases, the Eurydice story forms a frame that directs where and how the poet can extend and use it. Built-in understandings and explanations, and already defined moods and images come to mind when the story is retold, and these form surfaces against which the meanings, images, moods, thoughts, and emotions of the new material

bounce and reflect. The underlying story imposes a strong sense of what would be in keeping with it. And approaching the Eurydice story from any direction, the story itself does its own refracting.

⌇

Filippo is secretive; he works in isolation—perhaps because of his looks: short, long nose, recessed chin, thin lips—and his dress doesn't help: he is typically messy and dirty. After losing the competition for the Baptistry doors to Lorenzo Ghiberti, he and his young friend Donatello travel to Rome to study Roman art and architecture. Filippo would stay on and off for 13 years.

Rome is a mess. Those left live across the river from St Peter's. The rest of Rome is an urbanized wilderness. Great Roman buildings serve as markets, pens, storehouses. Filippo's not here for the Christian sites, not the relics like fingers and legbones, not the cribs or heads. Neither is he here for the hucksters, the beggars. He is here for Rome, for the greatness that was once Rome. Romans could build things that cannot now be built, buildings whose sense and beauty and proportion cannot now be matched. Their art was not over-elaborated; it was clean and precise. It was austere but not flat.

And how did they build? Like Neri's model their domes didn't need supports like sticks holding up a bad roof. Filippo spends months observing, measuring, taking notes in his secret way—in his code. He and Donatello dig for remnants—for pots, for utensils, for coins and medals. He returns every few days to the domes—specially to the Pantheon. Neri's dome would be about this size, he reckons. Taller but about this big around. How did the Romans do it? Those cracks—when did they appear? The coffers—are they for decoration or to make the dome lighter?

They sleep under any overhang. They eat what comes along.

⌇

A designer struggles to create a first draft of a design, then, not to be merely an important step in the design process, but in order to create a collaborator that will make the remainder of the design process easier—not a literal collaborator with a brain, sharp wit, and funny hair, but a concrete thing (almost some sort of being) that helps direct the thoughts and actions of the designer. —A collaborator that triggers thoughts and directions that would never occur to the designer were the artifact not sitting there, staring back. To many outside the arts this statement is a profound surprise and enduring mystery. Eliot wrote:

> *In a poem which is neither didactic nor narrative, and not animated by any other social purpose, the poet may be concerned solely with expressing in verse—using all his resources of words, with their*

history, their connotations, their music—this obscure impulse. He does not know what he has to say until he has said it; and in the effort to say it he is not concerned in making other people understand anything. He is not concerned, at this stage, with other people at all: only with finding the right words or, anyhow, the least wrong words. He is not concerned whether anybody else will ever listen to them or not, or whether anybody else will ever understand them if he does. He is oppressed by a burden which he must bring to birth in order to obtain relief.

–T. S. Eliot, *On Poetry and Poets* [9]

There is something inside that needs its birth. There are right words or least wrong ones to express what it is. The poet is not constructing something in Eliot's description, but *finding* the words to go with this *obscure* thing. It is as if the thing itself is directing the blind poet; as if the thing itself is designing itself or at least designing its expression.

In my book on the writers' workshop I recalled what I heard many times in workshops and in the classroom. It went like this:

> *In the creative writing workshop, you often hear comments like these: "What is this piece trying to be?" and "What is the center of this work?" These comments aim at an attitude in which the piece exists on its own in the world and the reviewers are trying to get at its essence and make the best of whatever it is.*

–Richard P. Gabriel, *Writers' Workshops…* [10]

Stephen King says the same sort of thing when he argues that there is not much planning in the kind of writing he does (which can't easily be mistaken for poetry):

> *You may wonder where plot is in all this. The answer… is nowhere…. I believe plotting and the spontaneity of real creation aren't compatible…. I want you to understand that my basic belief about the making of stories is that they pretty much make themselves. The job of the writer is to give them a place to grow.*

–Stephen King, *On Writing* [11]

This reminds me a little of the ideas of Christopher Alexander, maybe after a bit of a stretch. Alexander believes—and this is pretty clear from his recent book (in 4 volumes collectively called *The Nature of Order* [12]) that "life"—which is both a literal term as well as a term that refers to that quality of built objects that are whole, lively, wonderful, comfortable, bittersweet, and generally where people want to live their lives—emerges from the geometric characteristics of the features that make up (things in) space. He defines

a concept he calls "centers" and 15 characteristics of them—alone and in combination—and he argues that if something has a sufficiently strong set of centers as measured by the number and richness of their characteristics, then it is *whole* or *alive*. In earlier work on patterns and pattern languages, he called this quality the *quality without a name*.

An essential part of Alexander's thoughts on centers is that their existence is objective—not the result of an in-the-eye-of-the-beholder theory. His view is (almost) that someday a computer program with sensors could be used to find them—and the ones thus mechanically found would be precisely the ones just about every person from just about every culture would find. Spiritual to the end, Alexander sees centers as the "I," an underlying Godstuff:

> *It is ultimate, beyond experience…the core of all living structures…the driving force behind what must be done. It lies in me and beyond me, is without form and name, lies behind matter, is connected to all living structure and therefore is impersonal….a kind of light….the spirit which animates, but a material or physical spirit….the face of God.*
> –Christopher Alexander, *The Nature of Order* [12]

A few years ago I used Alexander's ideas to construct a hypothesis to explain what poetry is—namely, how poetic writing differs from ordinary writing—and a method for revising poems by identifying weaknesses in them. In essence, the method works by finding places to revise and suggesting avenues for revision. After listening to Brooks's talk, I started examining how Alexander's theories can be used to explain the process by which an artifact participates in its own design and how conceptual integrity springs from the strengths of the thing designed. I began this examination with my theory of poetry.

To start to see what we think of this idea, let's take a quick look at the concept of centers and the 15 characteristics, and see how they apply to the process of writing poetry. I've put all the material on centers in a box up and to the right; you can skim it or skip it and use just the gestalt of my poetry example to get the idea.

For Alexander, the process of design and building is an iterative process. The first two steps, in their original simplified form, are as follows:

1. At every step of the process—whether conceiving, designing, making, maintaining, or repairing—we must always be concerned with the whole within which we are making anything. We look at this wholeness, absorb it, try to feel its deep structure.
2. We ask which kind of thing we can do next that will do the most to give this wholeness the most positive increase of life.

Center: A center is any place in a poem that attracts attention; centers can arise from the action/interaction of these craft elements: stress/unstress; sound; unit of syntax; rhyme; repeated words and sounds; line; first word in a line; last word in a line; stanza; image; metaphor and other figures; title; the poem itself; historical or political elements; revealed metaphysics; meaning

Levels of Scale: centers at all levels of scale

Strong Center: a center related to many other centers

Boundaries: separates a center from other centers, focuses attention on the separated center, is itself made of centers

Alternating Repetition: strong centers repeated with alternating centers; not simple repeating; pattern with variation

Positive Space: a center that moves outward from itself, seemingly oozing life rather than collapsing on itself

Good Shape: a center that is beautiful by itself

Local Symmetries: a center with another nearby which is somehow an echo

Deep Interlock and Ambiguity: centers that are hard to pull apart; centers that derive power from surrounding centers; centers that cannot be removed without diminishment; centers that are part of several others

Contrast: differentiation, distinctness, discernible opposites

Gradients: softness; qualities vary subtly, gradually, slowly

Roughness: a certain ease; the inessential is left messy

Echoes: family resemblance not exact replication

The Void: stillness or literally a quiet point

Simplicity and Inner Calm: all irrelevant parts are gone; it is as simple and spare as it can be and still retain its life; nothing more can be removed; each part seems simple and simply made

Not-Separateness: at one with the world, and not separate from it

The remaining steps ask us to make the change and assess its effectiveness—continuing or undoing, depending. The kinds of things that can be done to increase life are to add centers (where there are only latent centers), strengthen centers, or apply (structure-preserving) transformations that introduce or strengthen the characteristics listed above.

⸻

Back from Rome, Filippo is engrossed in the cathedral. A competition for how to build Neri's dome had been announced, and he is preparing his model with his friend Donatello and the sculptor Nanni di Banco, son of the late *capomaestro*. He's worked out a way to build the dome without internal scaffolding or other support. Filippo's short temper and mistrust won't let him reveal all his ideas—just enough to win. He smiles, though, when his beautifully sculpted, gilded, and painted model—spanning 6 feet and 12 feet tall—tips the contest in his direction, mostly, and his plan is chosen—he is named *capomaestro*. —Along with his chief rival in the contest, Lorenzo Ghiberti…and two others. The wardens of the Opera del Duomo will let his plan go forward for ⅔ of the height, and then the plan must be revisited.

The cathedral has its new name, now, and all Firenze is in a tizzy over it: *Santa Maria del Fiore*. And Filippo walks

proudly through the city because he has been chosen to bring the people of Firenze Neri di Fioravanti's dome, the one they have always wanted. Neri's perfect design—to cap Arnolfo di Cambio's perfect design for the cathedral. For Our Lady of the Flower.
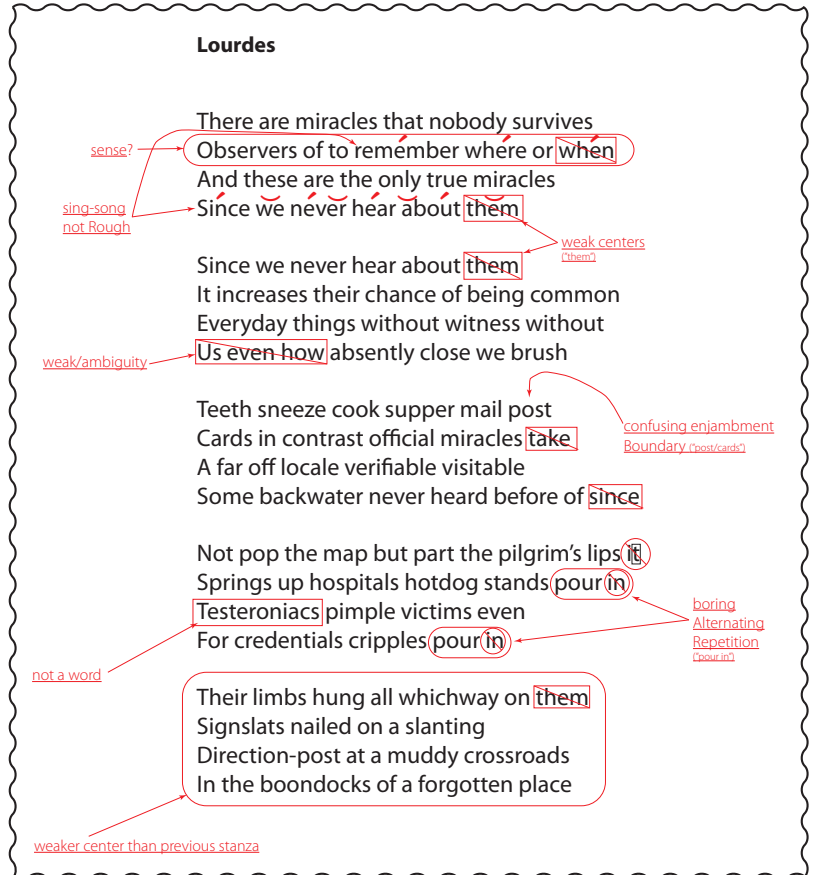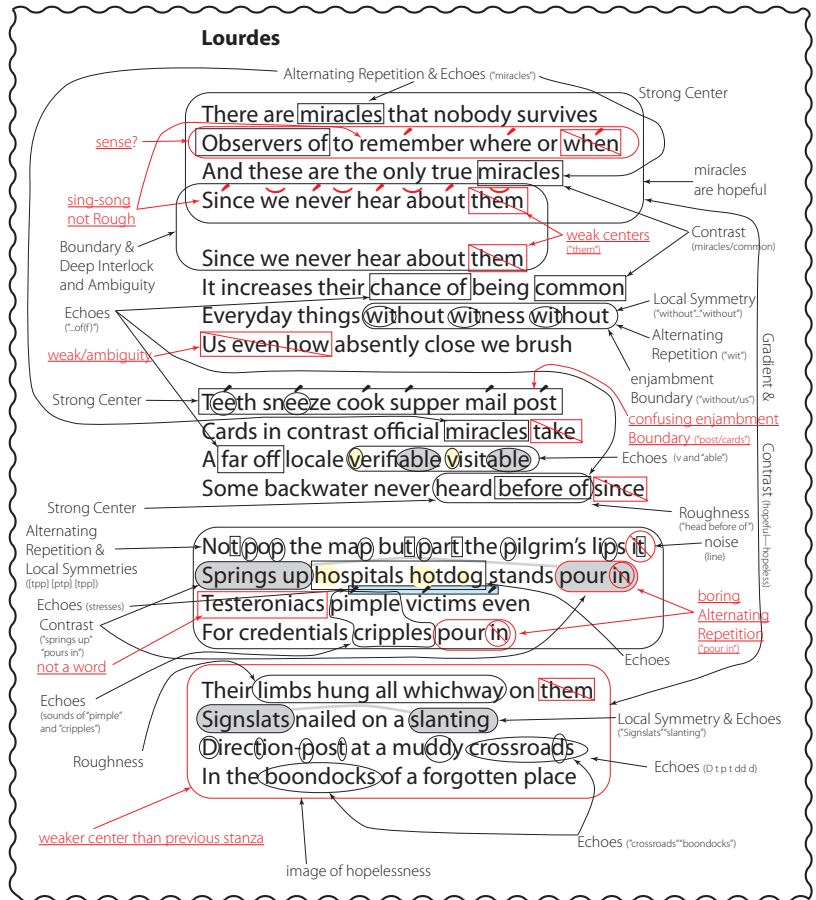
⌇

Extreme Poetry

To see exactly how an artifact might be a collaborator, I've pulled out an example from my MFA studies. Bill Knott is an important but ultimately minor poet. He writes funny poems that in many cases have their own brand of rationality. Knott's poems are short, which suits my purpose, and—absolutely most importantly—his published work contains a poem and its revision. The poem is called "Lourdes," and it first appeared in his 1976 collection, *Rome in Rome* [13]. The revision appeared in another collection, *Becos* [14], in 1983. To the right is the first of these, marked up with an analysis of its centers and their relationships. (The second copy right below it highlights the poem's weak centers.) Before you try to read it, some advice. First, poems are not necessarily for making total sense of— and Knott's poetry is often very nonsensical. Second, for the purposes of our exploration, it's not required that you understand the poem or even the deep meaning of centers and the characteristics as they relate to poetry—all that's needed is to see how the inherent strengths and weaknesses of this poem directed its revision (maybe). [see Note A]

Take a quick look at the poem and its analysis. The black (dark) marks indicate strong centers and red (lighter) indicate weak centers. A center is anything a reader notices, along with its connections to other, related centers. For example, imagine a simple 4-line poem that rhymes in the pattern **a-b-a-b**. A reader will notice the last word in each line, and also that the end words of lines 1 and 3 rhyme. The end word in line 1 is therefore a center, and its strength derives both from its appearing at the end of a line and also from the word that Echoes its sound at the end of line 3. And because the rhymes of the poem intertwine, the poem demonstrates Alternating Repetition along with Deep Interlock and Ambiguity, making the poem itself a strong center.

To spare you the details, I've put the complete explanation of the center-based analysis on my website [15]. I'll comment briefly on the centers in the first stanza, then move on to the weak

Lourdes

Alternating Repetition & Echoes ("miracles")
Strong Center

There are miracles that nobody survives
sense? — Observers of to remember where or when
And these are the only true miracles
miracles are hopeful
sing-song not Rough — Since we never hear about them
Boundary & Deep Interlock and Ambiguity
weak centers ("them")
Contrast (miracles/common)
Since we never hear about them
It increases their chance of being common
Local Symmetry ("without"…"without")
Echoes ("…of(f)")
Everyday things without witness without
Alternating Repetition ("wit")
weak/ambiguity — Us even how absently close we brush
enjambment Boundary ("without/us")
confusing enjambment Boundary ("post/cards")
Strong Center — Teeth sneeze cook supper mail post
Cards in contrast official miracles take
A far off locale verifiable visitable
Echoes (v and "able")
Some backwater never heard before of since
Roughness ("head before of")
noise (line)
Strong Center
Alternating Repetition & Local Symmetries ([tpp] [ptp] [tpp])
Not pop the map but part the pilgrim's lips it
Echoes (stresses)
Springs up hospitals hotdog stands pour in
Contrast ("springs up" "pours in")
Testeroniacs pimple victims even
not a word
boring Alternating Repetition ("pour in")
For credentials cripples pour in
Echoes
Echoes (sounds of "pimple" and "cripples")
Their limbs hung all whichway on them
Signslats nailed on a slanting
Local Symmetry & Echoes ("Signslats"/"slanting")
Roughness
Direction-post at a muddy crossroads
In the boondocks of a forgotten place
Echoes (D t p t dd d)
weaker center than previous stanza
Echoes ("crossroads"/"boondocks")
image of hopelessness

Lourdes

There are miracles that nobody survives
sense? — Observers of to remember where or when
And these are the only true miracles
sing-song not Rough — Since we never hear about them
weak centers ("them")

Since we never hear about them
It increases their chance of being common
Everyday things without witness without
weak/ambiguity — Us even how absently close we brush

Teeth sneeze cook supper mail post
Cards in contrast official miracles take
confusing enjambment Boundary ("post/cards")
A far off locale verifiable visitable
Some backwater never heard before of since

Not pop the map but part the pilgrim's lips it
Springs up hospitals hotdog stands pour in
Testeroniacs pimple victims even
not a word
For credentials cripples pour in
boring Alternating Repetition ("pour in")

Their limbs hung all whichway on them
Signslats nailed on a slanting
Direction-post at a muddy crossroads
In the boondocks of a forgotten place

weaker center than previous stanza

centers, which should direct Knott's revision, if my theory is right.

Each stanza is a center. The first stanza has connections to two others via the repeated word, "miracles"; these repetitions form Echoes or a sort of Alternating Repetition. The first stanza is about hope while the last is about hopelessness, so these centers (stanzas) are related by Contrast. Stanzas 2–4 are somewhere between hope and hopelessness, so all the stanzas taken together form a Gradient.
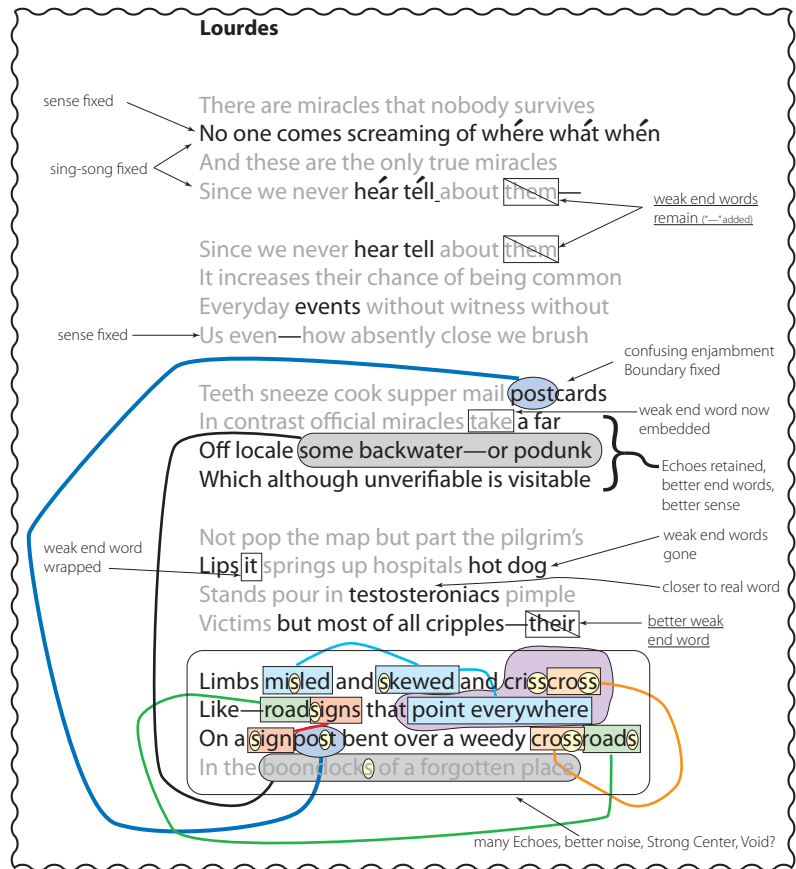
"Miracles" in the first stanza Contrasts with "common" in the second. There are Echoes in the phrases "Observers of," "chance of," "before of," and "far off," which link the first stanza to the next two. We notice these Echoes, partly because some of them are so unusual, and once we've noticed the unusual ones, similar-sounding phrases are lumped into the group. The Boundary between the first and second stanzas is clear cut because the lines are repeated; the repeated lines also form a Deep Interlock (because they lock the two stanzas together) and Ambiguity (because it isn't clear whether the line (really) belongs in the first or second stanza—Knott solves that by putting it in both).

That's how a centers-based analysis goes. Now let's focus on the weak centers in the poem. I've put just them in a diagram at the bottom of the previous page.

Most of the weaknesses are about not making sense or using weak words at the ends of lines. The major weakness is the last stanza, which just doesn't have as many arrows and black comments.

Let's look at the revision (up to the right). (Parts not revised are in grey.) All but two of the weak centers have been repaired (and one of them was strengthened). Better end words in general strengthen existing centers, and even when sentences and phrases remain the same, different lineation (line breaks) strengthens the centers. Subtle rhythm changes improve the centers—for example changing "hear" to "hear tell" adds a spondee (two stresses or beats in a row), which is a strong center, and also gives the first stanza this (nice) beat pattern: 4, 5, 4, 5 (number of stresses per line).

The real news is the last stanza, which is newly packed with centers—the intertwining and reinforcing of them within the stanza would take too long to describe completely here. Notice how "misled," skewed," and "point everywhere" bounce off each other and also off of "crisscross," which bounces off of "crossroads," which links to "roadsigns," which links to "signpost," which links to "postcards." etc. The noise is much better, it's clearer, and this stanza is now the Strong(est) Center in the poem. Even small things like changing "muddy" to "weedy" improve the sound and also make the image cleaner: a muddy crossroads is actually busy,

while a weedy one is abandoned. And its image—of a quiet, confused, and confusing nowhere with a Jesus-miracle-like quality—gives it a hint of The Void.

Most of the the the weak centers of the first version of *Lourdes* have been addressed. If a centers-based analysis is objective—as Alexander believes—then it would seem the poem has helped with its own revision and hence creation.

⤳

Consecration day—March 25, 1436, the Feast of the Annunciation—though the cathedral is not finished, not even the dome which is near its full height, Pope Eugenius IV has just consecrated Santa Maria del Fiore. Still left are the top of the dome—closing it's skyward-gazing eye with an 8-sided cap shaped a bit like a chapel to let light in—and the red tile facing on the dome itself. During the ceremony, the Pope laid all the cathedral's relics on the altar. One by one, the Cardinal christened the red crosses held in the hands of the wooden statues of the twelve apostles spread in a half circle around the altar—one by one, their spirits entered the cathedral, filling it with God's love. Not finished as a building, at that moment Santa Maria was complete as a cathedral.

Every bell in the city is ringing out.

The day is cruel cold. Filippo, his ears filled with cries of genius and dome maker, walks across the bridge and up the hill to the meadow where he looks back—tears in his

Lourdes

There are miracles that nobody survives
No one comes screaming of where what when
And these are the only true miracles
Since we never **hear tell** about them—

Since we never **hear tell** about them
It increases their chance of being common
Everyday **events** without witness without
Us even—how absently close we brush

Teeth sneeze cook supper mail postcards
In contrast official miracles take a far
Off locale some backwater—or podunk
Which although unverifiable is visitable

Not pop the map but part the pilgrim's
Lips it springs up hospitals **hot dog**
Stands pour in **testosteroniacs** pimple
Victims **but most of all cripples**—their

Limbs misled and skewed and crisscross
Like—roadsigns that point everywhere
On a signpost bent over a weedy crossroads
In the boondocks of a forgotten place

(diagram annotations:) sense fixed · sing-song fixed · sense fixed · weak end words remain ("—"added) · confusing enjambment Boundary fixed · weak end word now embedded · Echoes retained, better end words, better sense · weak end word wrapped · weak end words gone · closer to real word · better weak end word · many Echoes, better noise, Strong Center, Void?

eyes from joy, pride, and cold wind—back at the dome, at the cathedral. Clouds enclose the sky but cloudbreaks light up the city, catch the smoke rising up and quickly away. He fights an urge felt as an impulse from the future to raise his arms up and shout "I'm the king of the world." Instead he begins composing in his brilliant and fertile mind a sonnet of insult to those who doubted him.

⌣ᴎ

Poetry: why oh why poetry to explore design? Can't you give us software source code? Indeed I could. Easily. Poetry, though, is the "Queen of Arts" according to the poet Thomas Sprat [16], and one of the arts most obviously subject to creativity and individual talent and expression. I argue: if even a poem helps direct its own creation, why not the artifacts in a mundane discipline like software design? You want code examples? Read Martin Fowler's book on refactoring [17]. Here is how he begins his description of that book on his website:

> *Refactoring is a controlled technique for improving the design of an existing code base. Its essence is applying a series of small behavior-preserving transformations, each … "too small to be worth doing". However the cumulative effect of each of these transformations is quite significant. By doing them in small steps you reduce the risk of introducing errors. You also avoid having the system broken while you are carrying out the restructuring—which allows you to gradually refactor a system over an extended period of time.*
>
> –Martin Fowler [18]

The original design—however it came to be—guides the refactoring, just as the weak centers guide at least where and sometimes how to strengthen them. The design collaborates in its further refinement.

The centers-based analysis of poetry shows one way the designed can act as designer—in this case by using a method devised to elicit direction from the poem. Alexander believes that centers and their structure are how any geometrical design converses with its human designers [12]. In "Space: The Final Frontier," Jim Coplien applies the idea of centers to software and the creation of design patterns [19].

⌣ᴎ

Though Brunelleschi had enemies in Florence, he also had great admirers who managed to make him only one of two people buried in the cathedral—and the other is a Florentine saint. Brunelleschi is buried under a marble slab that reads:

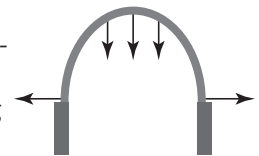*Corpus Magni Ingenii Viri Philippi Brunelleschi Fiorentini*

which translates roughly to "here lies the body of the great mechanical genius Filippo Brunelleschi of Florence." His epitaph, written by Carlo Marsuppini, reads:

> *The architect D. S. Quantum Philippus will be considered worthy in the arts of Daedalus because both the marvelous dome of this most renowned temple as well as many other things were possible through this example of machines invented by divinely inspired genius; wherefore, because of the exceptional gifts and singular virtues of this soul, on xv. Kal. May 1446 a grateful country commanded that his [well-deserving] body [of blessed memory] be buried hereunder in this soil..*
>
> –translation by Guy L. Steele Jr.

After Brunelleschi's death and before his burial, there was a plan to decorate his tomb site with pictures in marble of his mechanisms—and perhaps this explains the wording of the epitaph, where it says "this example." So why this emphasis on his mechanical ingenuity? Today Brunelleschi is known as a great architect and his masterpiece is the dome of Santa Maria del Fiore.

Most of what Brunelleschi did during the 16 years it took to build the dome (minus its facing) was to concoct devices for this or that: some large and impressive cranes and hoists, a barge to bring the gigantic logs and blocks of marble up the Arno (though it sank on the way to Florence), and a variety of mechanisms to make building the dome possible. These are not what we think of as architectural design but rather clever engineering. His model of the dome—with which he won the competition to build it—was either just like or mostly like Neri's before him. The ingenuity he brought to bear thought up a number of mechanisms that enabled the dome to be built without centering (scaffolding that supports the bricks while the mortar sets and the dome is completed). In any dome the two main problems stem from the downward pull of gravity; the first is that the top of the dome would prefer to be pulled down to the ground, and the second is that the force of gravity down on the center of the dome causes hoop forces that would like to spread the base of the dome outward, and in this case off of its supports.

Brunelleschi used 4 mechanisms to counter these problems. First is a double dome—one inside the other—which forms a box. Some believe the box-like structure accounts entirely for the dome be-

cross-section, viewed from the side

ing able to stand. Second is a series of stone and metal chains to keep the hoop forces near the bottom of the dome in check; though these were part of Neri's design, Neri did not design the chains in detail. The third is a set of circles embedded between the two domes—each circle forms a circular arch (parallel to the ground) which supports the inward forces where the inward slope of the dome is too great: just as an arch holds up a wall so a passageway can be made through it, a circle of bricks or other material can keep an inward-leaning dome from collapsing while it is being constructed. And finally there is a herringbone pattern for the bricks, which forms a number of smaller self-supporting sections of the dome as it's being built. One researcher—Massimo Ricci [20]—has proposed a slightly different theory of the mechanisms; the picture of the herringbone pattern above is of the model Ricci built in Florence to test that theory.

Ah, Brunelleschi *did* design the lantern, though he died just as its construction was beginning. The lantern is the structure on top of the oculus (the hole at the top of the dome), that serves as a source of light for the cathedral, a place to hang out for the rich and famous (and now for people like us), and something real pretty. This was his primary or only architectural contribution to the cathedral—and it was of a pure Gothic style, not a Roman-inspired style as was the hallmark of Renaissance architecture in Italy.

Most of the cathedral was designed and built before Brunelleschi was even born. He had the model of the dome that Neri di Fioravanti produced and which was accepted as definitive (when Brunelleschi was a child) by the wardens of the Opera del Duomo. And Brunelleschi had as collaborators the buildings in Rome and perhaps techniques from the Middle East that he studied with Donatello. (I should mention that ancient Rome was more technologically advanced than Florence in the Renaissance—the Romans had aqueducts, could build large arches and domes, and had essentially real cement and concrete.)

Most importantly, like all the other *capomaestros*, masons, and craftsmen before him (for 140 years), he had the cathedral itself in front of him acting as a designer's helper. The wardens, when they accepted his model of the dome, imposed milestones when the design and construction methods would be revisited. They remarked that at those milestones, the dome itself and what had been learned thus far would instruct them how to proceed.

The idea that the artifact can direct its design and construction is well established in biology, where it's called *stigmergy*, which its discoverer, Pierre-Paul Grassé, defined

as "stimulation of workers by the performance they have achieved." "Workers" refers to individuals in social insect societies [21]. Stigmergy is perhaps more prevalent than biologists believe.

Suppose you buy all this—suppose you buy that there is typically no such thing as a single mind behind conceptual integrity, and only rarely are as few minds as two behind it. Suppose you believe that the thing being built is a collaborator in its own design and construction. Suppose you see that the ancient Greeks and the story of Eurydice helped H. D. and Graham write their poems, that the inherent structure of *Lourdes* helped Knott revise it. Suppose you are happy that Eliot needed Pound to help him write *The Waste Land.* —Finally, that you admit that Brunelleschi *only contributed* to the conceptual integrity of Santa Maria del Fiore. Then why would it be so easy for someone as smart as Fred Brooks to believe that conceptual integrity springs from and requires a single mind? —Or that the first to market with something new and innovative will almost surely come away with the bulk of the market? And why is it so easy to believe this when the evidence that those things are not true is so trivial to find? Most of the information I provided about Brunelleschi came from Ross King's book, *Brunelleschi's Dome: How a Renaissance Genius Reinvented Architecture* [22]. This book informed Fred Brooks, and it's pretty clear Ross King, like Brooks, attributes more of the beauty of the dome to Brunelleschi than is deserved— brilliant as Brunelleschi's devices and techniques might be, he didn't "design" the dome in the sense of providing its conceptual integrity: he merely (merely!) figured out how to build it and directed its building, thereby preserving in its execution the conceptual integrity of what appears to have been Neri di Fioravanti's design. It's as if King didn't even read his own book.

(And fractal-style we could—no doubt—continue the historical investigation and find all the ways that the conceptual integrity of Neri di Fioravanti's dome arose from multiple authors, including Roman models, as well as from the dome itself mediated by the laws of physics and existing construction materials.)

Brooks was fooled. We've all been this same way. Many believe Ronald Reagan single-handedly defeated communism, Tim Berners-Lee single-handedly invented (everything about) the World Wide Web, Louis V. Gerstner, Jr. single-handedly rescued IBM in the early 1990s, Michael Jordan single-handedly won 6 NBA championships, Gillette invented the safety razor…. The list of people (and companies) given more credit than is due could go on, perhaps as long as you like.

There's something about our culture that seems to love heroes, that looks for the genius who's solved it all, that seems to need to believe the first to market—the best inventor—reaps justly deserved rewards.

Two factors combine to manufacture this love of heroes: a failure to perceive the effects of randomness on real life and a need for stories. A name and story are less abstract than an intertwined trail of ideas and designs that leads to a monument.

Randomness affects our perceptions two ways: When someone achieves something that seems rare, perhaps undeservedly rare, we seem unable to see the accidents of chance associated with it; and, second, we tend to ascribe to talent or skill alone a measure commensurate with reward, disregarding the role of randomness in the outcome.

In 1961 Roger Maris exceeded Babe Ruth's home run record of 60 in one season, hitting 61 that year. Maris was in a tight race with Mickey Mantle at the time, Mantle being the sentimental favorite. Maris was a good home-run hitter, but after his record season, he never hit more than 33 home runs. Many were puzzled (and greatly disappointed) that merely a good home-run hitter broke the dominating Babe Ruth's record. People examined Maris's stats and life to see why he deserved the record—they tried to construct a *story* to make his achievement coherent. How human.

"Deserve" probably has nothing to do with it. In 1960, Maris hit 39 home runs in 499 at bats. That means he hit a home run every 12.8 at bats or once every 3.7 games. Naturally, because of randomness, there can be streaks of more and less frequent home runs. Using a simulation to look at the probabilities, I figured a batter with Maris's 1960 skills would hit more than 60 home runs about one year out of 28. I read that a batter with Maris's 1960 stats comes along every 3 years. The question then is how likely is it that *some* batter between 1927 (Ruth's record year) and 1961 would break Ruth's record. I ran a simulation of that: a million 34-year stretches with a batter like Roger Maris appearing on average once every 3 years. The distribution of home runs for the simulated Maris showed a nice, but narrow, normal distribution—normal as in the bell-shaped curve—so the question is not whether it was possible some batter could break the record, but what the likelihood is. The revealed probability that someone would break Ruth's record turned out to be a little over ⅓. When I looked at the 81-year period from 1927 to 2008, the probability rose to 62%. Simulating Roger Maris for about a million years of baseball, I found that in his best years he might hit a little over 80 home runs, making Barry Bonds's 73 (the current record) seem puny.

Roger Maris was unglamorous and tightlipped about his game, so we don't know where he put the credit for his record year. But it's easy to imagine it being skill and talent plus a bit of luck. —More likely that than luck plus a bit of skill and talent.

It's a bit silly, then, to worry what it means for *Roger Maris* to have broken the record (first). In an important sense, it had nothing (much) to do with him. But we are wired to not be able to appreciate or perhaps even see that. Looking at Brunelleschi, the question occurs: Was he the Roger Maris of his time? Of the hundreds of cathedrals and their builders—many perhaps attempting to achieve something marvellous—were Santa Maria del Fiore and Brunelleschi simply outliers: just the right at bats during the right year?

Skill and talent play a role. Probability tells us that every batter has a normal distribution of hitting achievement. The skill of the batter dictates where the mean (high point) of that distribution lies. For someone of Roger Maris's skill, achieving 61 home runs in a year takes a lot of luck. If instead of Maris's talent, we take Babe Ruth's—with one home run every 11.3 at bats (instead of 12.8 for Maris)—then were someone like Ruth to come along every 3 years, the chances of breaking the 60 home run record in the 34 years between 1927 and 1961 would be 99.7%. For disciplines like writing poetry where talent seems to be at work, the practitioner can improve through practice, which has the effect of shifting the normal distribution to the right, increasing the "average" achievement.

The other side of misperceiving randomness is how we assess the talent or skill of someone with achievements. The answer is informed by an experiment conducted by Michael J. Lerner in the early 1960s [23]. In it, observers were led to believe they were listening to 2 people (Tom and Bill) working together to solve anagrams. In addition, they were told that, because of a budget problem, only one of the two anagram solvers was being paid, and that one by random selection. Instead of listening to an actual anagram-solving session, the observers listened to a script being read that carefully showed the two solvers equally adept at the task. Before watching Tom and Bill, though, the observers were broken into two groups. One group was told that Tom had been *randomly chosen* to receive payment, and the other was told that Bill had been *randomly chosen*; otherwise the two groups heard the same script being read. The observers in each group were then asked to state which person (Tom or Bill) demonstrated the better effort, creativity, and success at the task. Overwhelming the groups chose the one they were told was paid, even though they knew that the choice of who was paid was random.

This means that judging whether someone is a "hero" depends substantially on their reward or apparent achievement, and not so much on actual skill or talent. This is why, I claim, people generally consider the CEOs of successful companies as geniuses when their effects on their companies are usually minimal or insignificant. This is why Roger Maris must be better than Babe Ruth.

Stories are the rest of it. Stories contain lessons or at least signposts you can follow. Not that a trail can't be fascinating, but with no protagonist, interest tends to fade fast. —Someone to put yourself in the head of; someone you can pretend to be. When you have a living (or once living) protagonist, you can engage in biography, and from biography you can pinpoint facts and turns that strike you as significant, stuff

you can emulate. Want to save the world?—become a B actor; want to win a slam-dunk contest?—put on Air Jordans.

Maybe Fred Brooks paints chief designers with paint imbued with the brightness of their achievements—Lerner says that many of us do. Maybe Brooks finds it hard to attribute to luck and other factors the creation of the extraordinary—randomness has that effect on us. No matter; he remains a hero to me—let him be human.

Then there's this: when one mind can be solely responsible for a masterpiece or success, you have hope. With a little luck, possibly, you can be that special mind. Like a winning lottery ticket floating down—like the feather at the start of *Forrest Gump*—falling at your feet waiting only to be picked up and won with, that great idea could pop into your heard, turn up on your notepad, come out of your mouth while you're just listening to yourself (this is where "worse is better" came from). Maybe it's not that easy, but maybe it's possible. Then you'd be set, your career made, fortune gathered or fame cemented. Market share would be yours and…. We crave heroes as an existence proof of our own potential.

Or maybe we crave heroes to give us an excuse. When someone else is the hero, you don't have to be. When someone else will be the genius, you can just be who you are. No need to try extra hard…you're not that Turing Award winner, that MacArthur Fellow, that writer with a published novel. And you never will be.

⌁

The question, though, is conceptual integrity—does it require a single mind or something like it?

A single mind, if anything, is likely to be too uncontrollable to produce conceptual integrity—at least in the arts. Recall T. S. Eliot: "He does not know what he has to say until he has said it." Conceptual integrity comes from examining—in the case of poetry—what you wrote and finding its beating heart, finding its center, its core, and making everything around it support it or else disappear. Many times in writing, the eye and ear that can see clearly that heart are someone else's. —Or else the thing created itself steps up, says hey, look here, I mean *here*.

The heart of *The Waste Land* was there to be found in Eliot's original manuscript, but that heart was obscured by 600+ other lines and the mistakes and weaknesses that Pound pointed out. The conceptual integrity of the poem did not come from Eliot's mind—what he produced was conceptually diffuse (Pound wrote in the margin: "verse not interesting enough as verse to warrant so much of it," "too loose," and "rhyme drags it out to diffuseness" [24]). The poem's conceptual integrity was hidden within the draft—embedded in gubbish, and when that was cleared away the remainder was raw—and Eliot with Pound's help discovered and strengthened it.

The artifact supplies conceptual integrity more than any other collaborator, including the artist. The artist is the vehicle for noticing what the artifact shouts. The artist—as any designer is—is as great as his or her ability to be a great and expert observer and crafty reporter.

Christopher Alexander observed this when he was designing the foot traffic through Bay Area Rapid Transit (BART) ticket booths:

> *What bothered me was that the correct analysis of the ticket booth could not be based purely on [the requirements], that there were realities emerging from…the system itself and that whether you succeeded or not had to do with whether you created a configuration that was stable with respect to these realities.*
>
> –Christopher Alexander [25]

And it's not so different for software. An initial prototype or first design/implementation is created that does some of the job. The parts that are useful are selected for in a Darwinian sense, and finally (or next) the code is revised to reflect its central features, utility, and emerging structure [26]. —The whole Alexandrian thing; the whole agile thing. —Designed as designer.

⌁

The ingredients for conceptual integrity are these: the talent(s) of the human designer(s)—all of them; the thing designed; the luck that brought the designer(s) (and everything they needed) to the right place(s) at the right time(s); the luck of the thing designed to have the right ingredients.

Eliot and Pound had talent; Eliot's studies, travels, experiences, friendship with Pound, and Eliot and Pound being in France at the same time were fortuitous; Eliot's draft was fortunate that enough good stuff was there for Pound to see. Luck and randomness go against the grain of human cognition; it's hard to see the role of the thing designed in its own design; and thus typically only talent is given credit for great achievement.

⌁

Morning floods Firenze—the sun stains roofs, heat and smoke clog the sky in red. Emilio is long awake and before his mother begins cooking he turns onto his side in his rough bed and tries to picture the stucco façade of the Duomo and its faded decorative paintings. How such a cathedral—the glory of Brunelleschi—could be allowed to endure 500 years without a proper face makes him sad.

Today if his mother allows and there is time after his chores before the sun goes down, he will go to the plaza

and make some sketches—maybe make some watercolors later—get some ideas down.

He hopes someone, one day—a great genius perhaps—will be able to plan the façade, maybe see it built, and the cathedral will be completed.

⌣

In 1975, two young computer scientists at MIT began to puzzle out the then-peculiar theory of actors developed by Carl Hewitt [27]. Hewitt's model was object-oriented—influenced by Smalltalk following a historic seminar given by Alan Kay at MIT in November 1972. In the theory, every actor (object) is computationally active and can send and receive messages, which themselves are actors. An actor has a set of acquaintances it can send messages to, including messages containing acquaintances.

The two young computer scientists: their methodology was to construct a tiny Lisp interpreter for a toy Lisp and then to extend it to create actors and send messages. The two were Gerry Sussman and Guy Steele, and the toy Lisp became known as *Scheme* [28]. Because Sussman was studying Algol [29] at the time, they decided to build a Lisp with lexical scoping—and anyway, this seemed necessary to keep track of an actor's acquaintances. Here is how the simple factorial function was written in their toy Lisp:

```
(define factorial
  (lambda (n)
    (if (= n 0) 1 (* n (factorial (- n 1))))))
```

And here is the equivalent actor:

```
(define actorial
  (alpha (n c)
    (if (= n 0) (c 1) (actorial
                        (- n 1)
                        (alpha (f) (c (* f n)))))))
```

Here n is the (numeric) argument to actorial, and c is the *continuation*—the computation to perform after the one described in this definition. The values of n and c—passed in via a message—become acquaintances of the inner continuation actor created by alpha. Let me now quote Guy Steele writing in *The Evolution of Lisp* [30]:

> *Then came a crucial discovery—one that, to us, illustrates the value of experimentation in language design. On inspecting the code for* apply, *once they got it working correctly, Sussman and Steele were astonished to discover that the codes in* apply *for function application and for actor invocation were identical! Further inspection of other parts of the interpreter, such as the code for creating functions and actors, confirmed this insight: the fact that*

> *functions were intended to return values and actors were not made no difference anywhere in their implementation. The difference lay purely in the primitives used to code their bodies. If the underlying primitives return values, then the user can write functions that return values; if all primitives expect continuations, then the user can write actors. But the* lambda *and* alpha *mechanisms were themselves identical, and from this Sussman and Steele concluded that actors and closures were the same concept.*

> –Steele & Gabriel [30]

They used the word "discover," and that's what it's called in most scientific disciplines. Perhaps scientists construct statements in a formal language to express (an approximation of) each discovery, but naïve realism asks us to believe that the truth is there to be found. Sussman and Steele designed and constructed a working programming language. That language and its realization in code running in Mac Lisp [31] on a PDP-10 [32] taught them about programming language concepts, and helped them refine the language (its design) and its implementation to become one of the more important research languages in computer science over the last 30 years.

Perhaps Sussman and Steele knew, somehow, that actors and closures were the same when they started to write the code. The code, though, needed to speak to bring it to their attention. Or maybe, just as Steele said, they didn't know.

That what they write teaches is no news to poets & writers.

⌣

He won the competition to design the façade in 1871, and oversaw the beginning of its construction. —Red, green, and white marble, neo-gothic, though a bit over-decorated. His was the third façade on the cathedral, the first designed by Arnolfo di Cambio, the second—a painting over stucco—by no one worth remembering. He was mild, gentle, unassertive, and mostly self educated; many believed his success lay "in the sympathy which every one instinctively felt for his kindly nature, and in the gentle tenacity with which he adhered to his opinions while avoiding all open antagonisms" [33]. For years he studied the architecture of the Italian gothic period and especially the Duomo, and he learned—or should I say, the Duomo taught him—what the façade needed.

Like Brunelleschi he never saw the construction of his design completed. Emilio de Fabris—designer of the western face of Santa Maria del Fiore, as important as anyone to the creation of the Duomo in Florence, but someone you likely have never heard of—died on June 28, 1883.

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Notes

[A] When I found multiple versions of a poem, I would not read any of them; then I would perform my analysis on the first version; next I would look at the revision to see how predictive my analysis was; and finally I would analyze the revision. —etc The analysis of the first version of the Knott poem was done before I read his revision.