Distribution Agreement

In presenting this thesis as a partial fulfillment of the requirements for a degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis in whole or in part in all forms of media, now or hereafter now, including display on the World Wide Web. I understand that I may select some access restrictions as part of the online submission of this thesis. I retain all ownership rights to the copyright of the thesis. I also retain the right to use in future works (such as articles or books) all or part of this thesis.

Nicole Steiner April 3, 2020

The Discipline of Metaphor: How University Educators View and Use Metaphor

By

Nicole Steiner

Laura Otis
Adviser

Department of English

Laura Otis

Adviser

Lynne Nygaard

Committee Member

Benjamin Reiss

Committee Member

2020

The Discipline of Metaphor: How University Educators View and Use Metaphor

By

Nicole Steiner

Laura Otis

Adviser

An abstract of
a thesis submitted to the Faculty of Emory College of Arts and Sciences
of Emory University in partial fulfillment
of the requirements of the degree of
Bachelor of Arts with Honors

Department of English

2020

Abstract

The Discipline of Metaphor: How University Educators View and Use Metaphor

By Nicole Steiner

Introduction and Background: past metaphor research has revealed how unnoticed but pervasive metaphors are in human language [2], how human cognition around analogy and similarity, which is important for cognition around metaphor, may be what makes humans so smart [27], and how metaphors can alter an individual's reasoning outcomes, despite homogony of facts and figures between experimental groups [1]. The present study begins with the notion that, if metaphor is largely unnoticed but it can greatly affect a person's comprehension and reasoning, then metaphor is probably doing a great deal of unnoticed but influential work in higher education contexts. Professors and lecturers occupy a central role in the industry of information building and knowledge dissemination; therefore, how these educators use language in their research and teaching affects what students understand and *how* they understand it. It follows that how students learn will also affect what later information these students build, and how whole knowledge bases are constructed.

Methods: In the present study, eleven R1 university educators were sampled for interviewing from three disciplines: biology, English, and psychology. Interviews were recorded, transcribed, and analyzed.

Results: most professors believed that they used metaphor, and that it was important for research and education. Metaphors were found in terminology from every field, and all educators either failed to explain a phenomenon from their field without metaphor, or they were greatly slowed and challenged when doing so. Positive outcomes from metaphor included how cultural cross-talk about field terminology can

expose the flaws in metaphors, metaphor can make for clear examples, and metaphor can enact creativity by connecting two previously unconnected ideas. Negative outcomes from metaphor include creating or propagating terms or practices which lead to discrimination, unclear metaphors making for confusing examples, and more. Many participants also agreed that metaphor can be nonlinguistic, such as in “miniatures” in movies, diagrams in any field, and communicative movements such as gestures. Future interests include gathering in-class data of professors use of metaphor, and other topics such as metaphor’s relationship with ethics, and metaphor’s relationship with narrative, and how narrative builds comprehension.

The Discipline of Metaphor: How University Educators View and Use Metaphor

By

Nicole Steiner

Laura Otis

Adviser

A thesis submitted to the Faculty of Emory College of Arts and Sciences
of Emory University in partial fulfillment
of the requirements of the degree of
Bachelor of Arts with Honors

The Department of English

2020

Table of Contents

PREFACE

My view of language and thought has been woven like a braid by English, linguistics, and psychology. This thesis was born because I came to see that metaphor exists uniquely in each of my majors. At Emory University, many students study to be doctors, and this exposed me to fields like biology and chemistry as well, but I wasn't so sure that students or professors from these various fields also saw how metaphors were so prevalent. At the crossroads of these disciplines I wanted to know, how does metaphor— something that lies within and yet also transcends language— make its appearance? It seemed too much to ask in one purely empirical study. I wanted to do something a little exploratory, too. I wanted to be open to being surprised.

The goal, then, became to find how people from various disciplines *think* they use metaphor, and how they *actually* use it. Professors became a natural population to investigate, as they are knowledge finders and disseminators in all disciplines. I wanted to use this population to ask if metaphor is important both for the speaker and for the learner, and on how many levels of language metaphor comes about. Do experts in a field know the kinds of metaphors that they use and that work in their field, or do they stick to more technical, "literal language?" Aren't examples and explanations often conveyed with metaphors and stories to ground the information? How are these experts teaching people, consciously or unconsciously, to think *with* metaphor, and how to think *about* metaphor?

A project was born. It turns out that at the hands of professors, quite a lot of work is being done through metaphor, whether their effects are seen or unseen. The work of metaphor is sometimes for the better, and sometimes for the worse. I hope I will be back to tell more in the future about metaphor and how it influences human comprehension, views, and conventions of thought in learning settings, and in other settings of mentor/mentee learning.

INTRODUCTION: PREVIOUS LITERATURE AND THE PRESENT STUDY

In 2011, a study was published about how metaphor can affect reasoning [1]. The construct of the experiment was simple: participants were divided into two groups, each of which read a similar passage about increasing crime rates in a fictional city. The only difference between the two passage-types was the type of metaphors used: crime was either described as a "virus" or a "beast." After reading their respective passages, the participants were asked two questions: one, what should be done to intervene with the crime spread, and two, *why*. Or, in other words, what's your reasoning?

The results were striking. Those from the crime is like a "virus" condition responded with a desire to implement social reform and to spread information to protect the public from the spread of crime. To them, the people being pulled into crime were in some sense victims, people who needed to be protected from something infection-like. For the participants in the crime is like a "beast" condition, however, the results were different. Most of the respondents in that condition wanted to capture and punish the crime-spreaders, treating crime-spreaders as monsters who were fully responsible and punishable for their actions [1]. Ironically, when all of the study's participants were asked for the reasoning behind their answers, most pointed to the facts and figures, not to the metaphors being used in the passage... even though both groups' passages had identical data, and therefore the data could not be responsible for their systematically split responses. When metaphors change what information is highlighted, it can affect which social attitudes are stimulated. Somehow, though, we don't realize it.

This study, titled "Metaphors We Think With: The Role of Metaphor in Reasoning," by cognitive scientists Lera Boroditsky and Paul Thibodeau, is not the first scientific study to take interest in how metaphors interact with the human psyche. Four decades ago, linguist George

Lakoff and philosopher Mark Johnson wrote a book that has become a sort of Genesis of metaphor research, titled *Metaphors We Live By [2]*, which outlines their theory of conceptual metaphor and how metaphor pervades our language and thinking, and yet how it is somehow so overlooked in our conscious reflection. Metaphors such as "*high* prices" (recruiting spatial terms to talk about monetary amounts) are often interpreted as literal, but Lakoff and Johnson argue that we are thinking metaphorically when we use phrases like these instead of meaning them literally, since this metaphor began as something metaphorical before it became conventional to the point of being unnoticed by the public [2].

Another investigator who has conducted research about metaphor is Dedre Gentner, and she has studied analogy and similarity (among other topics) for many years. She has studied both adults and children, and how children come to acquire analogical ways of thinking. Yet, even for fully developed adults, metaphors still slip between the cracks of conscious awareness. *Why?* Although the present study won't explain or investigate this question in search of a mechanism, work by Dedre Gentner reveals that people are not oblivious to metaphor because we're simple minded, but because we're so *smart* [27]. We are tuned to noticing and accepting how one thing can bear likeness to another thing, and we easily create and interpret meanings through these connections. Most of us, unless formally trained, don't fully understand how the respiratory system works, and yet we engage with it every moment. Mastery can make something seem invisible.

Ground zero of the problem, then, is that human intelligence can make it so easy to process metaphor that we're unaware that we're doing it. But the first level of consciousness that contributes to the issue of metaphor being underappreciated and under-noticed, I imagine, is that many people adopt the assumption that metaphor is a thing of books and poems, and its role

doesn't belong in places like research, thought, or anything non-linguistic. To many people, literature has been deemed the home and even the birthplace (and to some, the jail cell) of metaphor, and to some people, metaphor is even something *ambitious* (as is said in the *Stanford Encyclopedia of Philosophy* [4]). The irony is, metaphor is often part of both casual and formal conversation, an intended and unintended presence in our expressions. Metaphor is in the forgotten history of words we think of as literal; it is woven into core concepts in fields of study such as business and the sciences; and in fact, metaphor is not always linguistic. Metaphor exists in more than words, for any language-able metaphor must first be thinkable. This fact overthrows each of the dictionary definitions of metaphor I could find, which are at best limited, and at worst, straight-up wrong in their short-reaching and prescriptive scope. Thankfully, even though the formal and widely accepted definitions of metaphor aren't doing justice to the concept to which they refer, at least there are experts on metaphor who have spent their energy trying to decode just how deeply metaphor presides in the human experience, untangling and examining the nuances that go unseen by most laypeople. Experts, and well-regarded thinkers.

When Aristotle reflected on metaphor, he thought highly enough of it to consider a person who has mastered metaphor to be a "genius." Aristotle stated, "the greatest thing by far is to be a master of metaphor. It is the one thing that cannot be learnt from others; it is also a sign of genius, since a good metaphor implies an intuitive perception of the similarity in the dissimilar." [5] Aristotle raises an important point by recognizing that, to create or recognize a metaphor is to comprehend a higher-order likeness between objects or phenomena, something more conceptually complex than to recognize literal sameness. Metaphor involves recognizing or creating a relationship between two things that maybe have likenesses amid coexisting distinct dissimilarities.

The pervasive nature of metaphor is being revealed in new, modern ways, too. 21st-century neuroimaging research on metaphor has found activation in the somatosensory cortex when a person hears textural metaphors [6]. The somatosensory cortex is where our receptors to sensations of touch are mapped onto the brain, so this means that metaphors connect to our very bodies, not just language centers. We think with metaphor, and we also experience it with our own cells and sense of embodiment. Perhaps metaphor's role is not only in language, not only in thought, but metaphor is also at work in gesture and is therefore responsible for some of this mind-body connectivity. When people gesture, they recruit the space around them to talk about abstract ideas, such as spinning one's fingers around each other to talk about cycles, or raising a hand to talk about prices going "higher." This is metaphor. We embody metaphorical meanings all the time to aid in communication and comprehension.

An important truth that I acknowledge throughout this thesis is that despite the benefits that metaphors can reap when they are used well, not everything about metaphor is praise-worthy. As we will see in research by Rosemarie Garland-Thomson, metaphors can not only mislead thinking, but they can systematically discredit whole groups of people such as those with illness or disability. This happens both in the real world with an example I will explain about *Illness as Metaphor* author Susan Sontag [25], and examples in literature Garland-Thomson has written about, such as with Tiny Tim, a character who has no depth aside from his ailment, or a character whose "evilness" is assisted by giving him a lost body-part or unusual physical trait, Captain Hook [17].

Indirect harm from metaphor, or rather from a *lack* of metaphor, can also exist, such as in medical settings. This is why I chose to have Biology as one of my subgroups, because I know this is an area of study pivotal for students who are pre-med (planning to be doctors). If

metaphors aren't used to explain a phenomenon that the patient can't understand in literal, medical terms, this may leave comprehension gaps in the patient's understanding of their condition. One particular example of this is in an article about how to explain nociceptive pain for cancer patients. Many of the examples are metaphorical (e.g., "how the brain controls two top-down systems that can either inhibit (the brake) or facilitate (the accelerator) pain., or the example of nociceptive pain "using the spam filter metaphor to illustrate descending nociceptive inhibition" [7]. Perhaps lack of metaphor and the conceptual breaking-down of information, be it in a medical setting or in a classroom, contributes to the gap between how well surgeons think they have communicated, and how well communicated with the patients feel. In "Doctor-Patient Communication: A Review," the authors found that, "75% of the orthopedic surgeons surveyed believed that they communicated satisfactorily with their patients, but only 21% of the patients reported satisfactory communication with their doctors" [8]. Could this kind of gap between the expert and novice also exist between a professor and a student? Experts think that the facts are enough, but explanation requires scaffolding language such as metaphor to teach new ideas more concretely to non-experts.

To investigate these potentially hit or missed opportunities for learning about metaphor and learning through metaphor, I decided to interview professors and lecturers at R1 universities, sampling from the three disciplines of biology, English, and psychology. These disciplines sample the hard sciences, the humanities, and the social sciences. Therefore, these three disciplines offer a good place to begin my work because the kinds of knowledge built in these areas differ significantly, but they can also overlap with each other, and overlap with other fields.

My method of interviewing incorporates a strategy of research called "Grounded Theory." In short, I began the study with some predictions that will be either encouraged or

discouraged by my data, but I also am intending to give some free space for findings I didn't predict would arise. These were my predictions:

- Generally, professors from the hard sciences (biology) would be less aware of metaphors in their fields and how important they are, compared to professors in the humanities (English.) Professors from social sciences (psychology) might be in the middle or vary greatly, considering two researchers who have studied metaphor are in the population of interviewees I gathered.
- All interviewees would have some unnoticed metaphors in their fields, which might at least begin come to light under conscious reflection in the interview.
- Some metaphors would clearly have "good" or "bad" effects on students/the world.
- Both living and dead metaphors would be found in each field (terms to be defined).
- I also intended to leave space for unexpected findings that can guide future research.

Sources: Interviews and Background Literature in Metaphor

My primary sources are 40-60 minute interviews which I conducted, recorded, and transcribed. There were a few secondary source texts that guided the formulation of the questions for my interviews, which tend towards the more conceptual side of this work. These texts include the sources already cited, but also *Making Truth: Metaphor in Science* [9]; Dedre Gentner's and Brian Bowdle's "The Career of Metaphor," and others mentioned previously in this introduction. *Making Truth: Metaphor in Science* was an invaluable introduction into the uses of metaphor in biology and chemistry, areas of study I am not especially familiar with in my own education. Metaphors mentioned include the "an atom is like the solar system" analogy. It is also promising that an academic working in the field of Biology would have come to the realization that

metaphor was relevant in his field many years before I came to this subject. There also exists an extensive literature about metaphor in the field of cognitive psychology, which is especially intriguing in my work with a metaphor expert, Professor Dedre Gentner.

Interviewee Population Specifics

My interviewees included 11 people. From the field of Psychology, I interviewed four professors: two from Emory, Marshall Duke and Andrew (Andy) Kazama. The other two psychology professors came from Northwestern University: Dedre Gentner, who is an expert in analogy and similarity, and Sid Horton, a psycholinguist.

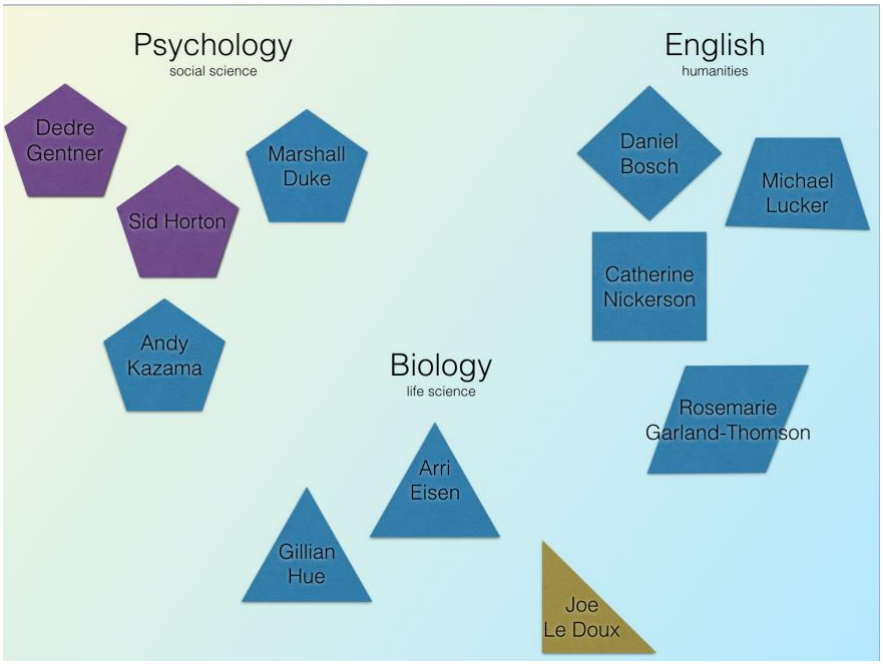
From the field of English, I interviewed two lecturers and two professors: Daniel Bosch, a lecturer and poet; Michael Lucker, a screenwriter and adjunct faculty member at Emory; and Rosemarie Garland-Thomson and Catherine Nickerson, professors of English at Emory.

From the field of Biology, I interviewed lecturers Arri Eisen and Gillian Hue, both of whom are interested in ethics within biology, and the effects of culture on knowledge and learning. Joe Le Doux is a biomedical engineering professor at The Georgia Institute of Technology who has also taken an interest in learning sciences. It is worth noting that all the professors with whom I spoke from biology had some experience in how one's way of thinking and one's unique cultural or academic background can affect learning and how information needs to be taught. No professors in the field of biology without interest and experience in ethics or learning sciences responded to my recruitment emails.

Below is an image representing the distribution of interviewees with whom I have been working in this project. (Purple shapes are interviewees from Northwestern University; the blue are from Emory University; and the gold is a professor from The Georgia Institute of

Technology.) Each of them brought a valuable new perspective and knowledge to the project. More detailed information about the individuals I interviewed can be found in the appendix.

figure 1



Human Subjects Research Permissions

This study was reviewed and approved by the Emory IRB, and all participants gave informed consent and signed the necessary forms. My aim is to uncover phenomena that indicate what metaphor *truly* is and where it *truly* lies. I quote the participants to reflect their responses accurately.

To begin to enter my data and what I found, first a few terms must be defined.

DEFINING TERMS: LIVING VS DEAD METAPHORS; METAPHOR VS ANALOGY

The first terms to define are the parts of a metaphor: a tenor and a vehicle. In a phrase, *X is like a Y*, the tenor would be the "X," the subject that is being given an association in the

sentence. It's like a borrower. The vehicle would be the "Y," the object that is lending its attributes to the subject being explained. The vehicle is the lender. In cognitive science the tenor and vehicle are sometimes called the target and source, respectively. For example, in the metaphor, "books are teachers," *books* is the tenor/target, and *teachers* are the vehicle/source.

LIVING AND DEAD METAPHORS

Although the separation of dead" and "living" metaphors isn't the focus of this study, this distinction is important to the metaphors discovered and discussed in this study. Below are some examples of metaphors; some more "dead" than others, as will be discussed later in the section.

Am I *getting this across* to you?
I *see* what you mean.
That movie was a *blockbuster*.
The *face* of a clock. The *hands* of a clock.
My spirits are *high*. My spirits are *low*.
Prices are *high*. Prices are *low*.
A *long* time ago. A *short* time ago.
What's *on* your mind?
That bookstore is a *goldmine*.

A fully dead metaphor has lost its original meaning and even the original connotation. An example provided by Gentner was *blockbuster*. Blockbuster originally meant a bomb that can take out a whole block. When people call something a blockbuster these days, they aren't usually aware of the source meaning, though, which makes for a truly dead metaphor. These other phrases, such as "high" and "low" to talk about prices or moods, may be easier to trace, even if they still take a moment to register as being nonliteral. We can realize that a price isn't located higher in space, but that spatial location is being used to discuss quantity. Higher is more; lower is less. When we utter these metaphorical ideas in our day-to-day lives, we probably aren't thinking that we're speaking creatively. We aren't, given that these are conventional terms. But,

if we slow down and analyze these sentences, we can see how they *might* have come from metaphorical linkages. But *when* did these terms lose their obvious-metaphor-ness? By this way of thinking, does this mean that metaphors have a *lifespan*?

As mentioned in the introduction, the Genesis of the study of metaphor is the well-known and controversial work by George Lakoff and Mark Johnson, *Metaphors We Live By*, published in 1980. This work brings to light how metaphor is suffused in language, especially where it hides unnoticed in places like conceptual metaphors. Specifically, three kinds of conceptual metaphors exist: 1. “orientation metaphors,” which relate concepts in terms of space (e.g., high prices, low mood, long time); 2. “ontological metaphors,” which act much like personification in that they map human-like behaviors and feelings onto something which cannot or does not literally perform that behavior or feeling, e.g., my phone died, my dog complained, I’m hungry for success, the sky is crying, the car sputtered; and 3. “structural metaphors,” which lend a concept from one domain to help articulate another concept, such as explaining the concept of time as something which is a resource, like energy or money.

Other forms of figurative language can count as metaphoric, too. For example, metonymy and synecdoche. Metonymy is a form of figurative language where instead of calling something by name, it’s referred to by a mere associated feature of the whole thing or a related idea. So, this would be calling a lamp a “light,” the president’s office the “oval office,” or business men “suits.” Of these examples, the ones that refer to a part of the whole to identify the whole are examples of synecdoche, a type of metonymy. In his interview, poet Daniel Bosch claimed that most types of poetic tools are really just versions of metaphor, and metonymy and synecdoche are no exception. As Lakoff and Johnson write, “Metonyms seem to be more obviously 'grounded in our experience' than metaphors since they usually involve direct associations” [2].

These can be quite metaphorical expressions, because we aren't thinking a lamp is literally just a light (it has concrete parts to it, not just the emission of light, and the light emission function can be turned off) and not *any* office in an oval shape is the president's office, and non-businessmen wear suits/businessmen wear things other than suits sometimes (we assume, anyway). Our attention is called to part of the whole, not to make us forget the whole but to see the whole through the part that is being called out.

However, as is often the case between thinkers, not everyone agrees with all of the claims made by Lakoff and Johnson. Their thesis about conceptual metaphor claims that when we use a conventionalized, conceptual metaphor (such as blockbuster, or high price) we're still thinking metaphorically, even if the metaphor is dead or nearly dead. Psychology professor Sid Horton was among those I interviewed who don't agree with the conceptual metaphor idea:

> **I** don't agree with everything that George Lakoff has said over the years, but I think that is one thing he got right is that a lot of the ways that we use language has metaphors embedded in it… So I think… we often aren't aware of it, that doesn't mean we are thinking metaphorically in that moment. That's where I kind of depart from the extreme view. (Horton interview.)

Horton is not alone in this stance. Just because something has roots in metaphor doesn't mean it still exists as metaphorical. Dedre Gentner also had comments about the originary work of Lakoff and Johnson:

> **L**ike all of Lakoff's metaphors, in most cases people… don't feel like they're saying some creative thing. When they say 'he was boiling over'…they're just totally conventional. On the other hand, you know it is still relational and it's still in some senses telling you how important it is that we see one domain in terms of another so much sort of becomes a schema… 'blockbuster' is an example Brian Bowdle and I have used. (Gentner interview.)

Idioms are like this as well; they're just longer examples of dead metaphors, Gentner said. They too are estranged from their original meaning and have taken on another meaning.

Gentner's work with Brain Bowdle on "The Career of Metaphor," talks about how novel metaphors become conventionalized. They begin with a more local meaning and develop a more extended meaning, such as *blueprint*. Originally this word just had the literal meaning, a blueprint for a house or a building. But eventually it took on an extended metaphorical meaning of "any kind of a plan laid out." In this way, a term begins to lend itself to become a common referent for comparisons or categorizations.

Of course, there's also a distinction between metaphors and similes to define, too. Similes are a type of metaphor but have this "like" or "as" linking the tenor and vehicle, whereas in a metaphor, this middleman is laid off. Is there a psychological difference between the two? Apparently yes:

> **T**he metaphor form may lend additional pragmatic force to the statement. Because novel metaphors will initially give the hearer pause, they should call more attention to themselves than novel similes and may therefore be taken more seriously. In summary, our findings suggest that whether figurative statements are processed as comparisons or as categorizations will depend critically on two factors: the conventionality of the base term and, in the case of conventional expressions, the grammatical form of the statement. (Gentner interview.)

As helpful as the expert's lucid explanations are, I found that a few other interview participants had a great deal of knowledge and interest in living and dead metaphors, too, such as Daniel Bosch, the lecturer and poet. He said he uses an article in his classes about dead metaphors so that people will become aware of how "use and abuse or overuse can kill a metaphor." Because he is a poet himself, this idea of a fresh or not fresh turn of phrase has very real, very practical

importance. He said, “I like to use the notion of dead metaphors as a way to drive people towards fresh ones.”

Quite a handful of dead metaphors were called to mind when I asked professors to talk about metaphors that had become conventionalized into their respective fields.

Living and Dead Metaphors: Are There Inherently Metaphorical Terms in Your Field?

When I asked professors if they had noticed any terms in their fields that were inherently metaphorical, many paused, unsure if they could find one “off the top of their heads.” By the end, there were many terms consciously recalled, and I also noticed some metaphorical terms produced spontaneously in the interviews.

Dedre Gentner, of course, noted how many metaphors we have for the mind and for the brain in psychology. Mental functions and concepts are not very concrete, and so they must be described metaphorically, such as “search,” “storage,” “retrieval,” and so on. Sid Horton talked about the parts of language which range from “low level” aspects like phonology up to “high level” parts of language like pragmatics. But what about those who have never studied metaphor or read about “The Career of Metaphor”? Psychologist Andy Kazama noticed terms on his own:

> **… “e**xecutive function.” There’s no executive in the brain, it’s a metaphor in some ways of what the frontal lobe is doing in terms of how “it’s the boss." It's the one part that is taking everything your sensory system has brought in, and the central executive is the part that is going to be making that decision to say, *ok how are we going to interact with this reality that we have constructed?* (Kazama interview)

Psychologist Marshall Duke made an interesting remark on how behaviorism isn’t interested in what’s going on inside of the mind; it only wants to focus on what is physical and visible. However, B.F. Skinner himself, the scientist regarded as the founder of behaviorism, used

metaphors such as “the black box” to explain the un-seeable, unexplainable psyche of creatures and what underlies their behaviors. Even those supposedly concerned with the quite physical, literal world couldn't refrain from using metaphor to explain their views and ideas. Many terms in psychology have metaphoric roots.

From the engineering perspective, Joe Le Doux talked about heat and how that word has a different meaning in common speech vs. in formal thermodynamics. So if a person says “don’t let the heat in” on a hot day of the summer, they’re speaking as if heat were a substance, which is wrong in formal thermodynamics. It doesn’t flow, but it’s something more technical, a transference of energy. Another common metaphor is “feeding” cells: giving the cells a fresh cell culture medium and getting rid of the toxins produced by those cells.

A striking example came from Arri Eisen. He addressed the ubiquitous idea of mother and daughter cells in cell division, something most students in the United States learn in middle school and high school. Eisen is part of the Emory Tibet initiative, which has posed opportunities to question accepted metaphors because he teaches Western science to Buddhist monks:

> **I** was teaching the monks and one of them raised his hand… and he says, *how do cells die?... When one cell divides it seems like the original cell isn’t there anymore so did it die or are there two new cells or is it always new?* …And when we learn biology… from 6th grade to 10th grade, you learn that there is a mother cell, and two daughters. The mother cell doubles everything and divides into two. Well it’s not really a mother and two daughters. That’s the metaphor we use, but… coming from a Buddhist point of view, where everything is cyclical, you don’t die and it’s the end. You die and are reincarnated and you’ve been doing that forever. He’s coming from that, and he got right to the heart of the weakness of that metaphor, which I had never thought about. So when there is a real mother like your mother she doesn’t die when she has her kids right?… it’s a great

> example of showing, well, where do metaphors come from? They come from your culture. (Eisen interview.)

Eisen explained that he did his best to answer the monk's question by first explaining the facts, without the conventional western metaphors that layer on top. He said that the mother cell isn't exactly "living" or "dying" because "she" splits her DNA, replicates it, and splits into two. Did she die? No, not in the way that biological terminology technically defines cell death, such as the system of apoptosis, which is programmed cell death. But the way that death has been defined isn't just about objective facts, but how our culture has worded and defined things, in a way that is quite culture driven. Eisen reflects that the terminology given to phenomena is affected by who discovers the phenomena and what kind of culture and way of thinking they come from:

> **A**s a Buddhist, if they had discovered the cell cycle, they would have probably talked about not mothers and daughters. They would have used some different language because of the world they were coming from…it's not trivial. It turns out the language you use then drives the next experiment. Because if you are thinking of it as a mother and a daughter, you're going to come up with a different kind of question than if you are thinking of it as a recycled life. (Eisen interview.)

Eisen went on to share a second example that is talked about in the book he co-authored, *The Enlightened Gene* [23]. In the book he reveals that the very word "cell" is a dead metaphor. In 1665, Robert Hooke discovered cells. However, he had been looking at a cork cell, which is a very particular kind of cell with quite strong and has clear, definite walls in its structure. It looked like a monk's cell to him, (ironically), and so that is why he called it a "cell." Considering all cells and their variability in appearance, most cells don't look like cork cells. Also, they're 3D shapes, not the flat 2D images that we usually work with in biology classrooms. Students' conceptualizations of the size, shape, and general anatomy of a cell can already begin to show distortion and misshape their conceptualization of what a cell is and what it looks like.

Living and dead metaphors manifest themselves differently but just as crucially in screenwriting terminology. They incorporate ideas from other fields such as biology in thinking about the inciting incident as a "catalyst" to the story. Screenwriter Michael Lucker listed many other examples which have to do with ideas of equilibrium and toxicity and also seem to stem from biological ideas, and spatial metaphors:

> **…T**ake the high road, take the high road…equilibriums: at the beginning of the story you start with a broken equilibrium. And that means the world is dysfunctional, we see it in a lot of old westerns with Clint Eastwood where he may ride into a town that had a bad sheriff or bad villains running the town, and he comes in to stop that. (Lucker interview)

I mentioned to Lucker that he had earlier used the term "emotional rollercoaster." He smiled and said, "See, I don't even notice anymore! Rising action, stakes escalating… these are all tenets of storytelling which help give structure to the film and make sure it builds and doesn't diminish." The structural function of these words makes a lot of practical sense. A story, which evolves over time, is an abstract, immaterial thing. Grounding it in spatial language helps make the idea easier to keep track of.

In screenwriting, it seems that the metaphors Lucker mentioned aren't just things that are said in the films, but vocabulary for a writer creating the film's story. They're part of the industry. They function not just artistically but practically. However, the stories we tell aren't just the ones in fiction, in books or movies, but the narratives we create about our own lives and the lives of people around us… and certain populations that are harmed by the stories that others tell about them. Rosemarie Garland-Thomson brought to light much of the under-cover work metaphor has done to discredit certain people and their ways of being in the world:

> **D**isability slurs are actually slurs that people don't realize are metaphors…when you call someone an *idiot*, what you are doing is invoking the language of early

> 19th-century eugenics, in which there was a category of being identified as an idiot that was supposedly measured by . . . what we think of as IQ tests. Which were eugenic instruments used to identify people understood as developmentally and mentally inferior, so that they could be targeted for possible involuntary sterilization … *Lame* of course refers to what we think of now as some kind of a mobility impairment. But it's simply used to discredit something, to say that something is bad or not effective … a very popular one is *crazy* or *insane*. (Garland Thomson interview).

Although there is much to be said about the kind of work that should be done with regard to minding our metaphors and what kinds of history of discrediting or discrimination they do, Garland-Thomson also points to the real issue: metaphors are *representations*; they don't communicate the thing itself, but a bite-sized version of the thing. It's like looking at a picture of a tree instead of an actual tree; some of the truth and dimensionality will be lost. So with the wrong metaphor, ideas, places, events, groups of people can be viewed at best as overly simple or slightly inaccurately, and at worst with blatant discrimination. With all of these risks, the solution isn't a matter of controlling metaphors, but at least coming to understand them first:

> **I**t's almost impossible for us to not use metaphors in our language. So what we'd want to understand is that metaphor is not to be policed; it is to be understood. Because of course metaphor is a specific form of representation, and all language is a form of representation… the typographical or orthographic representation "C-A-T" is not equal to the furry being that people like so much…it's also highly reductive. But it's also productive, (Garland-Thomson interview)

An example of representation that has done some disservice is that of representing *cancer as war*, in that system of metaphors. Sometimes giving certain themes of metaphors for issues in the world does a disservice to those who are living in close contact with those metaphors. Garland-Thomson recommended to me works by Susan Sontag, a writer who survived breast cancer and subsequently wrote *Illness as Metaphor [25]*, where she ridicules these metaphors of war in

cancer, and how they do a disservice to cancer patients, even to those who survive, apparently, and have "won" the "fight," as Sontag has.

Garland-Thomson talked more about how representation works within metaphor:

> **I**t's a very specific system of representation, it's vivid. It can make new meaning. And that new meaning does a certain kind of work in the world. So that's how I would want to talk about representation in general…representation structures reality rather than representation as a reflection of reality. (Garland-Thomson interview)

For Garland-Thomson, it's not so much about what terms are alive in literature that are metaphorical, as about what terms are in the language which have insidious roots. Our metaphors tell stories, even on the single-word level. So what are we representing in our living and dead metaphors, and how are we choosing to do it? The question, it seems, comes with many more risks and possibilities than any typical speaker would think possible.

One last term must be defined before we can answer this kind of question.

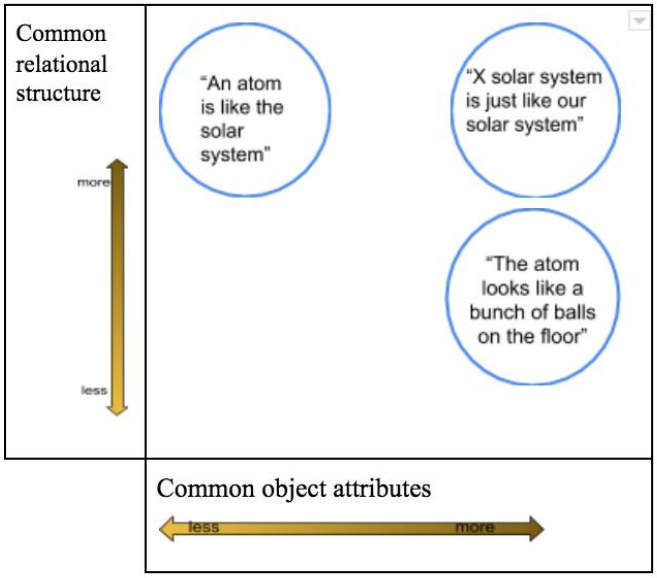
DEFINING ANALOGY AND METAPHOR

Of the following lines, which are metaphors, and which are analogies?

The road was a silver ribbon.
"Juliet is the sun" ([13], Shakespeare).
This time of my toaster breaking down is a lot like the other time my toaster broke down.
"What's in a name? That which we call a rose / By any other word would smell as sweet. / So Romeo would, were he not Romeo called." [13].
An atom is like the solar system.
"The voice of your eyes is deeper than all roses" (E. E. Cummings.)
A double dissociation works like cutting off the color or the sound from a TV.
The body is a machine.
"My surgeon is a butcher." (example from Gentner.)
She blossomed like a flower in spring.

As Dedre Gentner will explain, it's a bit of a trick question. Gentner has been studying similarity and analogy for decades, and she has been teaching and researching at Northwestern University in Evanston, Illinois since 1990. Often, she says, metaphor "is just a form of analogy," but some metaphors aren't analogical at all. Although only some metaphors count as analogies, the relationship between the two and their distinction (when it exists), is vital for understanding the purposes of this study.

figure 2



I produced my own figure here, but a similar one can be found in Gentner's work, "Analogical Processes in Human Thinking and Learning," pg 4 [11]). In her diagram, the top left "analogy" corner is filled with the example of "job/jail," the top right corner of literal similarity is filled with "prison/jail," and finally the bottom right corner of mere appearance has "zebra/jail" [11]. In this figure, the bottom right is "pure" analogy, such as "the atom is a solar system." In this kind of relational similarity, there exist few to no surface similarities (such as having a shared physical appearance.) The sun looks nothing at all like the nucleus of an atom, and we know that

they aren't similar in terms of size. The relational similarity is that there is a system of forces acting so that a central large object is affecting smaller bits orbiting that central piece.

In the top right of the image, there is a high amount of common relational structure and common object attributes, and Gentner gave the example of comparing our solar system with another solar system. I pointed out that this seemed literal, and she said it was: "This [is often called] literal similarity; you can also call it overall similarity." Although one may think that overall similarity is something simple to be avoided, it actually serves important functions. People must compare two things that are literally similar in many aspects, such as if a person's toaster breaks down and they need to figure out what to do: a person tends to compare it to the most literal comparison, such as the other time our toaster broke down, to access relevant information that can help solve the problem (example from Gentner.) Comparing one toaster breakdown to another is more useful than comparing a toaster breakdown to a lamp failure, or even the breakdown of another appliance such as the fridge. She compares these literal similarities to relational similarities:

> **W**e use these [literal comparisons] all the time… but sometimes a far match like this [the atom and the solar system] is much more revealing. Because none of the concrete details match, the abstraction leaps out at you. This is how many scientific discoveries are made. There's also something called sheer surface matches, and these are really dopey but we get them all the time. That's a metaphor like, "the atom looks like a bunch of balls on the floor," … There's nothing about this relationally that will give you any information about the atom. (Gentner interview)

However, as Gentner defined all this information about surface and relational similarities and what they meant, she hadn't yet talked about metaphor. Where does it fit in amid these surface and relational similarities?

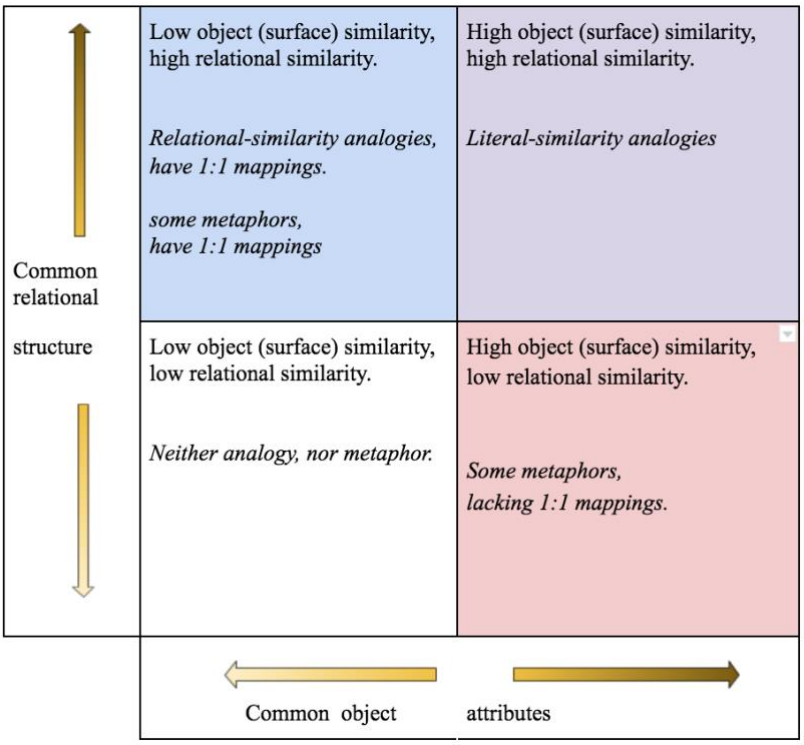
Gentner explained that metaphors can either be these "beautiful pure analogies" in the top left corner such as "Juliet is the Sun," to metaphors like "the road was a silver ribbon" in the lower right, which has no relational similarity (roads and silver ribbons don't share functions, just appearances.) There are also metaphors that are "mixes," lying somewhere between being fully analogical and not at all analogical. A crucial element of defining a metaphor as distinct from an analogy is the function: an analogy needs to be *structurally sound*. What does this mean, and why is it important? According to Gentner:

> **T**he atom [mapped to the] solar system… The nucleus goes with the sun, the electron goes with the planet, and so on. The electron revolves around the nucleus, the planet revolves around the sun, all these mappings are 1:1 and the same relational structure applies…But it's also perfectly OK to have structures that are not 1:1 … "The voice of your eyes is deeper than all the roses." That's from Cummings. OK, so I don't think that can be mapped, but you can certainly get something from it. So metaphors…some of them don't fit in this diagram because this diagram is all about essentially intelligible similarities, and they have some that aren't meant to resolve.

Metaphors and analogies have a lot in common, since both are "often meant to reveal something that wouldn't be obvious if you simply thought about the concrete facts, but typically analogies are about explanation and predictions." This is why analogies (or metaphors that have analogical structure) are probably the best to use for giving examples of some real-world phenomenon, as in science courses. An example that resolves will probably be more helpful. The mind can really parse it.

Without examples, then, here is a conceptual diagram about how metaphor and analogy overlap, except for the metaphors that don't even fit into this structure and are "unresolved":

Figure 3



Taking these distinctions into account, it's a bit easier to assess the examples listed at the opening of this section according to the criteria given in this diagram:

Surface-similarity metaphors that lack 1:1 relational correspondence:

- The road was a silver ribbon.

Metaphors that also count as analogies:

- Juliet is the sun (Shakespeare).
- She blossomed like a flower in spring.
- The body is a machine.
- That surgeon is a butcher.
- An atom is like the solar system.
- A double dissociation works like cutting off the color or the sound from a TV (Horton, in interview).

Literal analogies, not metaphorical:

- X solar system is like our solar system.
- This time of my toaster breaking down is a lot like the other time my toaster broke down.

- What's in a name? That which we call a rose / By any other word would smell as sweet. / So Romeo would, were he not Romeo called. [13].

Unresolved:

- "The voice of your eyes is deeper than all the roses" (E.E. Cummings, [12]).

On a last note, the ability to notice and describe relational matches as opposed to surface matches is something that takes time for the human mind to develop. Children aren't born with the skills for noticing relational similarities as adults do. Gentner says this is a matter of just needing to get enough *practice* with noticing and linking similarities:

> **L**ittle kids focus on object matches… "how is a cloud like a sponge?" and a three or four-year-old says, "both are round and fluffy!" and a nine-year-old or adult says, "both hold water and inevitably give it back." (Gentner interview).

In sum, metaphors and analogies are sort of Venn-diagram terms. When an analogy or a metaphor should be used depends upon the context, and the particular features plugged into the idea. Most likely, for teaching purposes, analogies are going to be more effective in describing scientific phenomena or how something works, but metaphors can be analogically structured. But there might be some metaphors that lack 1:1 correspondence and don't "resolve," but still get across a general idea or feeling that can still be helpful. Now, with terms defined, the next chapter goes into the answers to this question: what field(s) of study really need(s) metaphor?

WHICH DISCIPLINES NEED METAPHOR?

Perhaps this is a trick question, because no sooner do we begin to talk about who uses metaphor than we run up against the issue of conventionalized metaphors being present *everywhere*. That ubiquity can create confusion around the question. Metaphors that have become accepted terminology or dead metaphors that are conventional language to demonstrate an idea are part of the presence of metaphor, but probably most participants haven't heard a lot

about what dead metaphor is, and besides, the study is interested in how metaphor can be used for teaching and thinking, which should also be about fresh and intentional metaphor uses.

In my interviews, I didn't get into these qualifications, though. I simply asked: who needs metaphor the most, and who uses it?

When I asked Arri Eisen, he told me that teaching is disastrous if the professor doesn't use metaphors and instead tries to "pour information into you." He says that we've all had a teacher like this, a professor who thinks that the knowledge-sharing process is a literal transfer, like the pouring of a substance from one container into another. But this model for teaching doesn't work. Unfortunately, it's especially common in science teaching, he says. Probably because the experts come to understand the concepts on such a general, zoomed-out level, as the compilation of all the examples and ideas that they have accumulated, they lose track of how the examples and metaphors that they needed originally were so important for building their knowledge and making it accessible. He said, "That's what experts can do, right? They see the patterns. They may have forgotten the details but they see the patterns." Granted, sometimes there are the few unusual individuals who understand information in this literal way devoid of scaffolding, but it's not most people. Eisen says that if you really sat and talked with a professor in science in a face to face conversation, "it would all be metaphor." When a teacher is discussing an idea and having a conversation instead of trying to disseminate it in these cut and dried lecture formats, the metaphor comes alive. Eisen thinks, in fact, that the fields we think of as the least metaphorical are actually the most metaphorical. "the things you talk about in Physics, none of it can you see. There's nothing to work with but metaphors."

Gillian Hue had a similar perspective. She believed metaphor is important in all fields, even if it might be more prevalent in some than in others. She also mentioned that scientists may

think that they don't need metaphors as much as other scholars. I believe that some evidence for this lies in how my recruiting process unfolded for the field of biology. I sent out far more emails to professors in the field of biology and received scant responses back. Perhaps some of it was business, but it's hard to say for sure what kept them from agreeing to interview and to discuss if and how they use metaphor in their field, and if/how metaphor is important. Gillian Hue said that professors who don't think they use metaphor, likely ones from the hard sciences, are missing how some of the ways we think about concepts are deeply "formed by the narrative around how we come to be thinking about it…. The epistemology of what we know and what we value about what we know gets locked in place with some of the stories we tell ourselves about how things work and what is normal." The concepts that any scientist works with are part of a *narrative*, but we're just not fully aware of it in the hard sciences.

From the psychologists, Marshall Duke's opinions were consistent with those of the biologists, stating that ways of thinking in science are "certainly" informed by metaphor. He began to list examples: the idea of children being born as a "blank slate," and in chemistry the metaphorical image of a molecule as "like a solar system." He pointed out that you and I probably don't know if an atom truly does look like a solar system, since we haven't seen a molecule to validate the idea. But the importance of these metaphors is that "it helps us to think about these ideas. Really good scientists use metaphors."

The biomedical engineering professor Joe Le Doux agreed that metaphor is needed everywhere, but the metaphor skillset depends on the discipline. He reasoned that those who are good at metaphors may not choose engineering as their profession, however. Intuitively, it seems to make sense that a wordsmith might not be drawn to engineering… but is this true? Le Doux stated next, however, that "it seems to me [people who are good at metaphor] would be really

useful in areas where the more abstract concepts are, to make sense of things that are not intuitive." Thermodynamics, he pointed out, is an area where the ideas aren't intuitive and might need metaphorical demonstration… but it might not be an area of study that draws the masters of metaphor. So this raises a good question: To which fields are the metaphor-makers drawn? Are they only drawn to the areas of study that focus on language, or do metaphor-makers find themselves with all kinds of other interests and plug-ins for their skills?

Another important counterargument to address is that, if metaphor shows up everywhere, why become conscious of it? Why should teachers become alert to metaphor? Am I not saying that using it is an automatic skill? No: just because metaphor is an intrinsic impulse doesn't mean that it is impulsively done perfectly. As Roger Tabor has found, kittens are born knowing how to stalk prey, but they must watch their mothers hunt if they want to learn how to give the killing bite to the throat of their prey… the execution must be learned [26]. Or, for another example, just as humans are born with a general ear for music, that doesn't mean that most of us don't need training to understand how to name notes, how to compose music, how to stay on pitch, or how to translate a throng of minor chords into a coherent song that sounds not just like fractals of sadness but like a story about sadness. And how much more weakened would this very argument be, for example, if I didn't paint the picture with that analogical example? Teachers of all kinds need to train their ears for metaphor.

When I spoke to the professors from English, I was curious to see if they, too, thought that metaphor was important in all fields, and if they intuitively understood how abstract concepts from science often call upon metaphors, even though this is a different use than metaphors in novels and poems. Kate Nickerson immediately said that she hadn't been in a science course for a long time, but she recalls needing metaphors to understand some of the

concepts and memorize ideas. She broached that idea insightfully, but she pointed out that math might not be an area where metaphors are needed as much. However, in the humanities, her area of study, metaphors are important "because we are looking at the human response to the world, right? And that is frequently filtered through metaphor." She sees metaphors as prevalent and important both in the metaphors used in the texts, and also in the metaphors that an educator might carve out to explain things to students.

Andy Kazama did not seem quite as convinced that metaphor is needed, but he was not opposed to the idea. "If metaphors can be a way to help the student engage with the material and relate it back to their own life in a way that makes sense for them, then that's a powerful way to teach." He also pointed out that mathematics might be an area where metaphors aren't as important. Something that is already concrete and calculations based on that might not depend much on metaphor.

Horton began unsure about metaphor's universal necessity, but as he spoke, he seemed to talk himself into thinking that metaphor exists in all disciplines and is needed by each of them. He began with, "Intuitively, I think the more abstract the domain of the field is the more important metaphorical reframing is going to be. Physics is the classic example… especially as physics gets more in the quantum realm, it gets harder to envision, so then you have to talk about it in terms of metaphors or analogies because that's what allows people to actually grasp it and think about it." He then said he didn't think metaphors were unrelated or important for humanities, though, "because of course they are. Because that's about the human experience…. So I think I'm talking myself out of it." His first reaction was yes, metaphor will be more important in the fields that are abstract and need to be grounded via metaphor, but metaphors are clearly at work in the humanities too. He concluded, "So maybe I don't know."

I posed the possibility that maybe it's not about who uses metaphor more, or who needs it most, because they all do. Rather, the discrepancy is just in *how* each field uses them, to which Horton said, "Oh yeah, most certainly."

This issue of how metaphor is used was probably the most striking finding I had when looking at teachers of poetry, because in poetry metaphor is more slippery to define, and yet also more of an explicit focus. For educators like Daniel Bosch, a lecturer in poetry and creative writing, metaphor isn't just about how it is used in conventional language or how to describe a phenomenon, or something for scientific purposes. For poets, metaphor has all these uses, and then something else, something that is about not just clarity, but freshness. Bosch explained his approach to teaching a creative writing course and how he points out to students:

> **…h**ow stock their language is and how they're constantly using these filler phrases. And they are getting a little bit of a callus because I keep pointing this out and they're getting used to their failing this way…I'm trying to get them to a point where they're saying, OK, these common failures are really just opportunities for me to exploit. So when I have used a dead metaphor, a less fresh metaphor, in revision I can go back and make myself imagine, you know. Because…poetry needs to be imaginative, art needs to be imaginative, and we need to push ourselves to make imaginary objects, objects that induce imagination. (Bosch interview)

When we speak in metaphor or analogy, we are using relational thinking to draw up an understanding of how multiple things are similar: we must perceive and think similarity before we speak it.

Finally, I took this question to the analogy and metaphor expert. Who needs metaphor? In her response, Gentner began from a zoomed-out perspective, and she progressively zoomed in.

> **M**etaphors are a form of relational thinking, and relational thinking is absolutely critical to higher-order cognition. We do it all the time, and the more we do it in some sense, the smarter we are…And I don't just mean it in terms of your IQ is

> going up, but as a species, as a culture within a domain, I think relational thinking is absolutely critical. Seeing relational matches whether or not there is a surface match. (Gentner interview)

So, what we are doing in metaphor is something brilliant for a species to do, in general. But what about in our science, our disciplines? Gentner said our issue is that most of our metaphors are quite conventional, and it's no longer creative when a metaphor has become conventionalized, talking about "one domain in terms of another so much [that it] sort of becomes a schema." Gentner explains that in any field, metaphors pop up and become conventionalized and become schemas that have in some sense lost their creativity; they're just a default connection, the kind of stock language that Daniel Bosch talked about.

As a follow up, I asked Gentner if relational language is important for imaginary futures and hypotheses. Her response was an enthusiastic yes: "What you're doing with possible worlds is that you're taking the structure of something that you know and projecting it, and generally making changes to it. But without the basic structure it's just garbage. If you're just saying, 'I think something could be different out there,' you haven't done anything." The reason that science fiction or our hypotheses are interesting or plausible is that they begin by aligning with the structure of a reality they know, and yet have nodes of difference that are plausible or attention-grabbing. Our favorite TV shows or our imagined futures depend upon analogy.

If metaphors are needed in hypotheses and imaginary futures, does that mean we need metaphors or analogies to do science? Based on the participants' responses, the answer appears to be more complicated: some kinds of science, the "humble bricks," are like what Andy Kazama mentioned, the kinds of science that are calculations and therefore don't quite need or benefit from metaphor plugging into the subject. The distinction is that in noncreative science, with simple enough and basic enough functions, metaphor isn't needed. Otherwise, though, metaphor

and these kinds of connection processes are going to be important: Gentner said, “I think for creativity, for coming up with new ideas, analogy is going to be a really prominent part.” She mentioned that she would hedge on that statement, however, to say that some kinds of math models are analogical, but it’s “just a particular kind of analogy.” There’s still meaningful relational structure in some math models that can count as being a type of analogy. But, in sum, “I wouldn’t say that you can’t do science without analogy, I think that might be going too far.” Gentner’s investigations of the role of metaphor and analogy are described in “Where Hypotheses Come From: Learning New Relations by Structural Alignment” [10].

In sum, the respondents had a pretty good feel for the importance of metaphor as it varies by field. Everyone needs it, but in their own ways. The humanities may be the first-impulse for where to classify metaphor’s home in that the humanities are about the human experience, but in expressing abstract ideas, metaphors are also critical. So, the question becomes less about *whether* metaphor appears within a domain, because it’s a resounding yes. Instead, we should be asking about *how* and *where* metaphor appears.

MINIATURE EXPERIMENT: EXPLAIN A PHENOMENON FROM YOUR FIELD WITHOUT USING METAPHOR

Although the self-reports of the interviewees include a great deal of information on their views about their use of metaphor, I decided to put their opinions to the test. I asked: *Can you explain to me a phenomenon in your field without using any metaphors?* Here are some of the responses, in which I include highlights of metaphors (dead or alive), but I may have missed some. The green are most certainly metaphors, whereas the yellow may be up for debate.

> **Arri Eisen:** No, it’s impossible. I think some people would think they could do that, but as soon as they started, they’d realize that they were using metaphor.

Dedre Gentner: I think that I probably could do that with enough time, but it probably would take me a lot of time because I would constantly use an analogy and then try to figure out some way to not use it and so on.

Michael Lucker: OK, we can talk about breaking into the screenwriting industry… Hollywood is a very interesting place where you have so many smart, talented, driven, attractive, cool, dynamic people going out for just a handful of jobs. So it creates a very imbalanced world there… So there are a lot of people in this giant pot, there I am using a metaphor again, right? Trying to, um, get famous, get rich and drive a faster car and get the better paycheck and live in the shinier house, or whatever. And it creates this little bubble of toxicity. And it's very weird. Right? Whereas if you're not in Hollywood, people are happy being carpenters…UPS drivers…. professors…. shoe salesmen.

Catherine Nickerson: You know a femme fatale … in a crime narrative because she is beautiful, she is, hmm, now I wonder is iconoclastic a metaphor? I think it is…. Iconoclasts break icons so…. She is a rebel, that's also a metaphor right…. Hmm… she's very beautiful. She is mean. She wears dark lipstick. She kills at least one husband or boyfriend. She has a lot of secrets. She doesn't like rules.

Gillian Hue: I'm about to tell you about the neuron, and I'm going to describe it because I can't draw it right now, and I'm going to describe it as like the egg yolk (laughs) so, no not that… I'm sure that I could, but I think it would be terrible. I could describe to you the sleep/wake on off switch, and I could describe to you how REM sleep switches on and off, but even using the switch word is metaphorical. So it's named the "sleep/wake switch," there's really already something embedded in that naming of it. So maybe no…

Daniel Bosch: Yes, I will try it, but I've already explained that I don't expect to succeed. We play this game, "declare a metaphor free zone."…Hmm… I'm sure I can't…. Well, will you accept "um?" As a non-metaphorical utterance? And we'll move on. There's a metaphor.

Marshall Duke: If I have a rat, and every time the rat looks to the right. No see I've already put in a metaphor, every time the rat's head turns to the right, I give the rat a piece of food. The rat's head will turn to the right more frequently. Now

> what I'm taking out is the notion of reinforcement, and reinforcement is a metaphor. How do you reinforce it? You make it stronger. Right? Reinforce a wall you put beams against it, you can't use that... So pure psychology…I think, pure behaviorism, is as close to non-metaphoric as you get. So long as you don't ask how it works.

However, a few participants did decide to attempt the task, and as far as I could tell, they did pretty well.

> **Sid Horton:** One of the things that I study is language production. And within language production there is a phenomenon known as reference formulation. So the idea is you have to as a speaker decide how to refer to objects in your environment. …So if I wanted to direct your attention to this bottle, I could say 'the water bottle,' 'the black bottle,' 'the tall bottle.' Right? And my choice of how to refer to that thing will vary depending on whether or not there is another bottle in the environment, another black thing in the environment, whether or not you and I have talked about this before. Because I could just say "the thing," or just point.
>
> **Andy Kazama:** I want you to imagine that somebody strums a guitar string. That string is going to vibrate the air, those vibrations are going to vibrate columns of air that are going to be collected by the pinna. Those auditory vibrations pass down the auditory canal. The first structure they hit is going to be the tympanic membrane which is going to vibrate at the same frequency. It's going to be attached to the ossicles which amplify those vibrations. They hit the oval window, which then concentrates all that mechanical energy to vibrate the fluid that is inside the cochlea. The cochlea is aligned with this cilia on it that when they vibrate they depolarize. That depolarization travels up the auditory nerve through the thalamus and up into the auditory cortex. And that is how sound is perceived.
>
> **Joe Le Doux:** Oh, God (laughs)… I could say that 'the temperature is the average kinetic energy of the molecules in a substance.' Are there metaphors in there? Yeah, that's about as literal as I could get.

The point here is perhaps not so much whether it is at all possible to explain ideas from science without metaphors. The point is that it probably can be done for many, if not most things (or

even all, if you tried hard enough, perhaps?) Regardless, speaking in perfectly transparent language has to be done consciously, slowly, and inefficiently. It would maybe be possible, but why do it if it would take up so much dang time?

Metaphor's importance isn't just about whether it is "needed" or not, or whether it is the only way to communicate something. Rather, humans care about efficiency, and metaphor is efficient. We produce and grasp metaphor so *naturally*. It's a powerful communication device, when used well. Three professors seemed to succeed at the task, and yet how many professors and students, if asked on a whim, would say that they don't use metaphors very often when they're in class? How confused or slowed would they be if asked simply to *try* to do so?

I asked Dedre Gentner how she would respond to a professor who thinks he or she doesn't use very much metaphor/analogy. She said:

> **W**ell, probably I would say, gosh I'm out of wine. Nice talking to you. But if you were fun and interesting, let's say it was a fun person to talk to, I'd probably try to trap them into using a metaphor. Something like you do when you say, "Can you describe to me this important phenomenon?" and then, depending on how you and I felt, you could push more on the terms that they used. (Gentner interview)

Similarly, I asked Daniel Bosch how he feels when new students in his class don't think they use much figurative language in their daily speech. He said:

> **I**t's fun though, I mean it sounds condescending, but you're kind of characterizing the metaphor naive. People go around thinking that the transparent language is common, or that they use things that are not figurative with high frequency. My experience is that, no, it's very rare that we approach transparency or nonfigurative language… so it's fun, if you can be patient, to open them up to that. To see what starts happening if they start stumbling all over themselves. (Bosch interview)

METAPHOR OUTSIDE OF LANGUAGE

Perhaps one of the questions I was most excited to ask is whether metaphors must be in words. The question can be baffling, seeming to imply that the asker has forgotten that metaphor is a literary device. But considering the psychological components behind speech, one probably has to conceptualize something before one can put it in words. If any utterance must first be thinkable, maybe there are some thinkable metaphors that don't have to be speakable. They can perhaps exist in thought, in images, in the unspeakable.

Some striking responses to this question came from the humanities interviewees. It seems that creative writers are most well acquainted with metaphor as a "literary device," but they are also quickest to understand how metaphors live dissociated Batman-and-Bruce-Wayne lives.

Bosch said that he doesn't think that metaphors have to be in language, but can be in "visual objects." He posited that *experiencing* metaphor can be in something visual, but also in something touched, smelled, or experienced by other senses. He reflected that some people perhaps argue that a metaphor being *expressed* may require language, and that the idea of that stipulation wouldn't bother him:

> **I** want to reserve the possibility that there are powerful experiences of figures that we associate with beautiful objects that we want to be permanent, like poems and artwork and stuff, that are prelinguistic. So when you poke at it and try to explain it you rely on language, OK, fine, I grant that. But I still want to preserve the notion that I don't have to talk about it for it to have happened. I don't have to come up with the words for it to have happened. (Bosch interview)

Bosch granted that something experiential can be metaphorical, but perhaps the communication of that metaphorical experience must be in language. It's a clever and powerful hypothesis. However, when I asked our screenwriter about this, he was quite sure that metaphor can also be communicated non-linguistically. His first example was with "miniatures," something symbolic

in a movie that isn't spoken, but that acts as a kind of symbol, usually some kind of object that takes on a particular, symbolic meaning:

> **I**n screenwriting we call them miniatures…. So as an example, one of my favorite movies is *Gladiator*. And in that movie, our hero loses his wife and child…he's looking forward to getting back together with them in the afterlife… he carries his little toy dolls with him the whole time to remind him of who they are and so he doesn't lose track of their memory... At the end of the movie there's a wonderful moment where, after he's died, his best friend takes those little toys and he buries them. Because they've been put to rest. So yeah, I think it can be linguistic and nonlinguistic in films. And oftentimes the visual metaphors can be stronger than the audio ones. People can say one thing, but when you see… those toy statues buried in the dirt in *Gladiator…* you don't have to talk about it. And that's the beauty of good storytelling and good film, is that you can tell the story visually. (Lucker interview)

Unfortunately, the metaphors we tell can also become another way that damage and prejudice work in the world. Rosemarie Garland-Thomson explained, again in the visual modality, that metaphors can be nonlinguistic. Her first example was about "freak shows" that used to display people with unusual physical attributes and/or disabilities. In pop culture, we can think of the development of the circus with P. T. Barnum, and the peculiarities of the individuals he recruited. People become a spectacle. But is the freak show a *metaphor* for something? Perhaps so, if it is representing what is "beastly" or partly human, as Garland-Thomson says:

> **…t**he figures that are the best "freaks" are hybrids. So that means that they are category violations. So, somebody with excessive hair that grows on their face, and there are people with this genetic condition…very "exotic" disabilities…they were interpreted as being hybrids, a fusion of two dissimilar things. You could read those as metaphors…one of the things that [convergents] do is they call into question that which is human…And these visual metaphors of monstrosity or hybridity do that work. (Garland-Thomson interview)

Metaphors are perhaps best known for their work when they are robed in the garments of language, but real-life visual events or the constructed visuals of movies can represent metaphors without having to be, as Daniel Bosch puts it, "languaged."

This comment gets at a greater question that this study addresses: Is metaphor in thought, is it part of the language of thought, before it is ever part of a fully developed, matured human language? We think relationally, aligning structures that remind us of each other, when we think about how one kind of experience is like another, and these thoughts don't have to be verbalized experiences. I could reflect on the metaphorical relationship between the state of my messy room and the state of my messy emotions, aligning that structure where no words are found in the raw contents of the room or the raw contents of my emotions. It doesn't have to be spoken to be endowed with its metaphor-icity. It is just there, as soon as it's a thought. The figurines of a mother and child in *Gladiator* are metaphors throughout the arc of a story even if no words ever address the objects themselves. And this tells us about human thought and metaphor's scope all the time, as long as one's ear is willing to hear metaphor without language.

Humanities scholar Kate Nickerson made an interesting point about a principal metaphor in the beloved Harry Potter series, but it is not the sentence variety of metaphor, but a whole *theme*. This phenomenon resembles what Lucker talked about in screenwriting; however, in a book, a story-level metaphor must be put into words. Still, the thematic metaphor was an extended metaphor, transcending the individual words. Like an allegory woven into the fabric of the larger narrative, the Death Eaters are crafted to symbolize the Nazis. According to Nickerson:

> **I**n Harry Potter there's the whole business of the death eaters being Nazis. The narrative of Voldemort and his followers is very deliberately crafted to be a message about fascism… So I think that's a powerful message that she's trying to tell to teach children about racism. The whole business of muggles vs wizards,

> and then the whole business about the "mud blood." And the way death eaters and Voldemort are trying to root out and alienate and deprive and take away the rights of all of the mud bloods as well as the muggles. (Nickerson interview)

Reaching into the other fields with this question of whether metaphor requires language yielded mixed responses. Some were just as quick as the professors from the humanities to agree that metaphors need be not in words. Some hesitated before coming up with lucid examples of un-languaged metaphor, whereas others seemed quite unsure how to respond. It is an unusual question to consider. Andy Kazama responded:

> **I** haven't thought about it much to be honest, and I'm not familiar enough with the construct of a metaphor, vs an analogy, these are kind of confusing things for me. What is the defining feature of a metaphor? (Kazama interview)

It's a good question, one that I would ask Dedre Gentner for clarification, and truthfully there is no perfect distinction between the two, as explained earlier. The most important feature of Kazama's response is that whether metaphor requires language is just not a question everyone thinks about. Creating metaphors without verbal language doesn't have to be a fully conscious act, but that doesn't mean it isn't happening.

I found other information from Kazama about how metaphors might not arise in words, however. Kazama works with monkeys in his research, so I asked him whether monkeys create metaphors, even without language. Monkeys may not speak, but they may have some of the cognitive processes that underlie language that give rise to analogical (and maybe metaphorical) thought. Kazama responded:

> **W**ell, so monkeys don't have language. They have vocal communications for sure… So it would be difficult to imagine how you would use a metaphor without the use of language... [monkeys] are very intelligent and adaptive, so what we are really talking about is their ability to generalize their learning across different situations… and for sure monkeys have the ability to do that. They can see one

> situation and apply this general principle, problem solve, and then take it to another situation. So, one of the tasks that I have monkeys do is to learn this abstract concept of "oddity" … the monkey has to learn to always take the "odd" thing…So it's not like they can't do abstract thoughts, like *what is the different thing?* (Kazama interview)

Kazama makes a good case for how nonhuman primates may not have metaphors, but that is under the assumption metaphor must be in language. But can we access the content of the thoughts of monkeys enough to make a claim about the metaphor-icity of what they think, reason, and connect? It's hard to say… I imagine, though, that there is a possibility for analogical metaphor in their minds, especially with these abstract concepts of oddity. Could monkeys perhaps analogically reason about one odd thing in terms of another, or how one odd thing is like another odd thing, in their both being the odd thing out? It's a bit more meta, but it could be a legitimate baseline for analogical-metaphor cognition in nonhuman animals.

Other professors went on to wrestle with this idea of metaphors that aren't in words, and even further defining how the way we typically think of metaphor might relate to other phenomena, such as semiotics, the study of signs and symbols. As an example of a symbol, think of an arrow. This symbol doesn't inherently signify direction, but we agree as a culture what an arrow means. Psychologist Marshall Duke responded to the possibility of metaphor without verbal language by saying:

> **I**t depends how far you want to stretch the word linguistic. Because gestures and posture are metaphoric as well. You have to say, well is there something as nonverbal language? And there is. There can also be a metaphor for the culture or a representation of the culture that you grew up in. (Duke interview)

Duke offered the example of how we would make a symbolic gesture to represent a telephone. He asked me how I would make a phone with my hand, and I proceeded to make a phone with my thumb to my ear, pinky finger to my mouth, and the rest of my fingers tucked in. Marshall

Duke smiled and said, “you learned that from your mother. Did you ever hold the phone that way? Did you ever see a phone like that? Nope, but you did that.” He then asked me what his grandchildren would do to make a hand-shape to represent a phone. So, I mimed holding an iPhone, with my hand in the position of a person holding a brick. He talked to me, then, about what all this variation of gesture *means* and how it can be metaphorical in representing generations:

> **F**or me, a metaphor helps me to understand what is going on in another person’s mind, what they’re trying to make me think, an image that is trying to be communicated. A chart, a graph, a drawing? Yeah, that can be a metaphor… Brilliant writers can make amazing metaphors, but the painter can do the same thing…I would say stretch linguistics into Semiotics. Because when you go to semiotics, then you incorporate gardens, architecture… So if you stretch it to anything that has sign value… then it’s limitless. (Duke interview)

Science lecturer Arri Eisen wasn’t immediately sure what a nonverbal metaphor would be. But then he shared a lucid example:

> **W**ith the monks in India, we were showing them how complicated it is to deal with DNA, because every cell has 6 feet of DNA in it… we had 50 monks up on the balcony stretched out holding hands all the way around the balcony so it was about 200 feet worth of monks. And then we had to get them all into a space about half the size of this room. So we showed them, we were just demonstrating with that metaphor, that kind of active metaphor…how difficult that is. So then they all had to figure out how to keep holding hands but get into this space. (Eisen interview)

Eisen also identified that diagrams and other images can be metaphorical, and so did biomedical engineering professor Joe Le Doux. He also addressed how this kind of visual metaphor can have an edge that spoken metaphor doesn’t have: nonlinearity.

> **F**irst of all, language through words is incredibly imperfect. And you know when you have something you want to express to somebody and you want to get it all out in one fell swoop, or you are trying to write a paper you want to have it all there instantaneously. Our language is very serial, and it's an art to try to somehow [delineate] them. Because the images or thoughts flip through your brain really quick, and you have to capture it and pull them together and somehow then organize it and transmit it in some way where other people will get it. It's incredibly inefficient. Whereas an image will capture something immediately, and then you have to try to translate that into words. (Le Doux interview).

When I asked Gillian Hue about nonverbal metaphors, she came up with a list immediately.

> **. . . c**artoons, diagrams… I've done a lot of [gestures] in this interview. I'm wondering how that's going to play back for you as you're listening to the audio, right, because you're audio recording.... I can draw, move around, demonstrate things, I can point. But if it's just going to be an audio recording, I'm trying to be a bit more careful with my selection of words. (Hue interview.)

Although the question about metaphor without verbal language appeared to be initially startling in some cases, nearly every participant responded with a "yes" and offered clear examples in the end. It seems that researchers and teachers in every field have their own types of nonverbal metaphors relevant to their work, usually carrying meaning in a visual way.

THE BEST OF METAPHOR

If metaphors really are everywhere; if relational thinking is really so critical for intelligence; if metaphors don't even have to be in words; if metaphors don't have to be figurative but can even become "literal" conventionalized phrases and explanations; then, there's probably a *lot* that metaphors can do, and that they are doing all the time.

From the data in the present study, the general trends of the good that metaphor can do fall into 11 areas. However, before leaping into these, let's touch on some of the criteria that Dedre Gentner uses in evaluating whether an analogy is "good."

Effective Analogical Metaphor: A Four-Part Criteria

Dedre Gentner laid out these criteria:

- Is it structurally sound?
- Are the inferences true (factually correct)?
- Does it fit my communicative goal (are you getting the desired inference)?
- Does it have the right valence?

First, structural soundness is especially important, say, for a professor teaching a lecture. The concept has to be coherent in a 1:1 mapping to be analogical. Second, and probably the most self-explanatory criterion, is whether the relation and its inferences being communicated are actually correct. If you called the cell wall an "impenetrable iron wall," that wouldn't be right since we know cells need to shuttle in various substances and shuttle out others. Therefore, the *cell wall: iron wall* analogy wouldn't be correct. Gentner described the third criterion by saying that just because an analogy is accurate doesn't mean it's describing the right thing. A good analogy about how a key fits in a lock can't be used to explain something that isn't actually similar to a lock-and-key relation. Fourth and finally, does the metaphor have the right valence? "Valence" refers to the emotional positivity or negativity of the association you have with the object matches, or the domain which you're pulling into the analogy as the vehicle or source:

> **I**f you're trying to describe something that you think is a really cool phenomenon, you don't want to use a vermin as your analogy…There's an exception to this which I think was done on purpose to make a more striking metaphor. This poet,

> W.H. Auden, says, "a poet can no more define poetry than a terrier can define a rat," so if you follow that mapping, poetry gets to be the rat. He's a poet, he definitely is not trying to say that poetry is like a rat. But that's the point about analogy, and metaphor: it's not about the object matches. It's about the *relational* matches. But he's really flaunting it. Because in general when we choose a metaphor, we know that even though the object matches shouldn't count for the structural match, we know that there will be an emotional carryover, if it's something really disgusting or something really charming. (Gentner interview)

Valence, then, is about the feeling we have about the object matches. This is really about something that shouldn't matter or carry over in an analogy, but it does anyway.

With these in mind, what are the ways that metaphors can go right, when they are structurally sound, correct, fit for the goal, and have the right kind of valence?

One: Metaphors in Hypotheses and Imaginary Futures

Metaphors are essential to making new connections and for asking good questions, and we need metaphors to engage in hypothesizing and imagining futures. Still, metaphor is not needed "to do science" in a strict sense when the idea or task at hand is simple enough to be just a calculation or a continuous stacking of the "humble bricks," as Gentner said. It's creative scientific endeavors that require these more elaborate, analogical and metaphorical ideas and hypotheses.

Overall, metaphor's centrality to the kind of work done in any field is very real: it's not some exterior scaffolding to science but something deep and intimate, like a spinal cord producing stem cells of new thoughts to morph and change in ways specific to the body of knowledge.

Two: Literal/Surface Similarity: Good for metaphor *how*?

It sounds like an odd conclusion to make that metaphor is good for our understanding of surface similarity. After all, aren't we trying to get away from surface similarities in a good metaphor or analogy? That's what we're trying to get *beyond*, right? However, it is worth thinking about literal similarity because knowing what something *is* also includes knowing what it *isn't*. I have to know what is superficial if I am to have any chance at avoiding it. The "superficial" has an undeservedly bad reputation in many fields. Surfaces matter immensely!

If I'm looking for a striking, creative relation to put into metaphor, then I might come up with a relation like "the breakdown of my toaster was like the breakdown of my relationship." The relations map indicates how both the toaster and the relationship were so warm and comforting until they started to burn anyone else who got close enough and they sputtered out loudly before fading into cold, irredeemable silence.

The master of metaphor understands surface similarities well enough to know that they mustn't conflate surface and relational similarities, and this might be part of what makes a great author, a great researcher, or a great professor from any discipline. Again, knowing what something is as well as knowing what it isn't is essential for achieving true mastery. Maybe knowing metaphor intimately can enrich our understanding of surface similarities, both where they are valuable, and also where they can be misleading.

Three: Metaphors yield access to the invisible: Empathy, Concepts, and Creative Relations.

Empathy, concepts, and creativity are intangible, yet they can be made intelligible and mentally graspable due to our way of making them concrete through language. To return to the toaster-relationship metaphor, isn't it striking that something that can be tangibly felt, seen, and

heard can be related to something as intangible and abstract as a relationship? Not only do the source/vehicle (toaster) and target/tenor (relationship) lack any shared physical characteristics; a relationship doesn't even *have* physical characteristics. It may have physical evidence that manifests itself, say, in two people holding hands, but the relationship itself can't be touched. But how many songs have been sung about "broken" relationships? The very idea of "break-ups" comes from analogical thought, in seeing a physical entity and thinking, "that's like my experience with losing my relationship with this person." So much of what we experience and talk about is intangible in this way: time, love, hatred, fairness, justice, hope, laws, lying, betrayal, trust, imagination. Comparing the intangible to the tangible in a way that creates knowledge of both requires watchful intelligence.

Without metaphor, I don't know if I could say anything about how I *experience* my life. Or at least, I couldn't say anything with emotional weight. If I just had to describe the literal aspects of my life, like what was visible in a time or place, I wouldn't be saying anything at all about my internal state, which is the element we really care about in hearing stories from other people. We link people's pains and sorrows and heroism to our own lives, analogically, taking the metaphors in a story and seeing them as analogies or even metaphors for our own experiences. I haven't lost a wife and child and had to bury the figurines, but I've certainly lost people, pets, even some dreams that I've loved and had to put those losses to rest. Empathy has roots in metaphor and analogy. Our concepts of relations are in part formed by how we relate things with physical surface properties to those which lack them. But of course, we also have concepts of very physically tangible things.

As a brief mention, it seems feasible to imagine that metaphor helps the human mind to build concepts. But, concepts are a very abstract idea to work with in science and psychology,

and I am not as familiar with how to study and trace concepts and how they form as some experts who have a much greater understanding of how humans build concepts such as Susan Carey, who wrote *The Origin of Concepts* [14]. I mention this, though, because this could be an area for future work, to see how metaphorical and analogical language plays into how we form these abstract understandings of the intangible that we call "concepts."

To step beyond concepts and into creative relations, Marshall Duke addressed the idea of how metaphors give rise to making creative connections. For example, he noted how Pablo Picasso and Robert Frost are alike in the ways they riff on objects. The linkage between these artists may not be metaphorical, but it is analogical, and the likenesses between their works are non-literal and constitute a greater stretch than noticing similarities that go toaster-to-toaster. Also, don't illustrations in children's picture books often correlate with but add meaning to the words? We need to have concepts, which may be partly built from metaphors, to make certain kinds of connections creatively, maybe producing yet new analogies and metaphors.

A simple example of metaphors in concepts, which Dedre Gentner mentioned, is: how can we talk about our thoughts without the metaphoric language we have adopted for talking about the brain, thought, and cognition? What would be a literal equivalent to having something "*on* your mind?" Maybe you'd say "I have a thought about something." But what does it mean to *have* that thought? Are you possessing something physical? The statement, "There is a thought in my mind," still goes back to the metaphor of the "mind" as a container, a type of physical space. It's so natural to us to speak in metaphorical terms that we can't really run from it. Because we realistically don't need to evict metaphors, why try?

Four: Metaphors and Reasoning

In a key study referenced earlier, cognitive scientists Paul Thibodeau and Lera Boroditsky found how metaphor can affect reasoning (the "virus" and "beast" metaphor conditions). Their very title says that metaphor affects *reasoning*. The fact that respondents *thought* that their opinions and action plans were being formed by the data and numbers, but were actually being formed by the metaphors, was the critical finding. The connotations, surface properties, other relations, and/or valence of a metaphor or our associations can get in the way and guide our reasoning, potentially into a negative outcome. However, metaphor can play a positive role in reasoning, too. The important thing is that any powerful tool can do good, but it can also be misused if it is being handled with laziness, poor skill, or naivety. Metaphor allows us to connect the dots, and this special skill lets us grow and change in the world. After all, isn't this what Martin Luther King Jr did in his speech, "I Have a Dream"? He used this metaphor and the valence of dreams, and other features such as mountains and plains, and people have used his language to reason that we need to adjust our hearts, minds and policies to advocate for equality. Metaphors can be used as instruments for change, for action, for thought.

In our conversation, Dedre Gentner said that "relational thinking is absolutely critical to higher order cognition." Relational thinking includes relational *reasoning*. It's more than associations; it's something more complex. But we also use associations to help us through a reasoning process. Reasoning is a mental process of pulling in available evidence to arrive at a conclusion, which can be conclusions about facts, conclusions that form our beliefs, or conclusions that result in our feelings about something. It's deductive, but it's also based upon only the available sources of information, and so it can be swayed if the available information is incomplete or biased. To take one recognized similarity relation and use it to form a belief, draw a conclusion, act or respond emotionally, is a process of translation. Recognizing relational

similarities is a significant step, but to take these similarities and reason with them opens up new ways of understanding and acting upon the world.

Five: Efficiency—How Metaphors Are Like Hyperlinks

As the interviews in this study show, even an expert within a field will often refuse even to *try* to explain something about their field without metaphors. Or, at least, they will be slowed and careful with their words so that they can intentionally avoid metaphorical language. Even then, many still find themselves speaking in metaphors, be it in the conventionalized lingo of the field or trying to give a vivid and effective explanation. Creative and conventional language are entangled with metaphors because these metaphors work for us, whether we're inventing metaphors or propagating the existing ones. We see this in thinking about "*the hero's journey*," "*top-down*" and "*bottom-up*" processing, and more. Without these metaphors we'd waste time saying yet more words.

Much of what we have to communicate in the classroom would be much more difficult to communicate without metaphors. Calling the mitochondrion "the powerhouse" helps students to learn the function of mitochondria much more easily than if you went into all the details unique to mitochondria, using new vocabulary, about how this small part of the cell generates energy. The effectiveness of metaphor in this teaching scenario is that it shows the learners that they already know something about this new concept. They can use a skeleton of background knowledge to help as they construct the new knowledge that will be the flesh of their developing understanding.

This scenario of using metaphors to build new knowledge isn't the only time metaphor is needed, though. We still seek metaphors for talking about things with which we are *very*

familiar, things we are perhaps so familiar with that, ironically, we cease to see them fully. This is where the work of "defamiliarization" comes in, in the next section, an idea that comes from post-structuralist literary theory. This idea was raised by both Rosemarie Garland-Thomson and Daniel Bosch.

Six: The Reverse of a Hyperlink

Sometimes it's not just a metaphor that dies, but the whole conclusion of a story "happily ever after," or a concept used to explain a certain idea, like "after the rain comes the rainbow" to talk about how a hard time will be followed by better times. We call these narrative elements clichés. Clichéd language doesn't teach us anything new; it simply allows us to recognize the already familiar, which becomes dissatisfying. This recognition doesn't require actual *seeing*, the noticing and interpretation of detail. For example, how many of us have taken a moment to actually see someone whom we easily recognize, such as someone we love or a place we frequent, but we realize that they/it possess some a physical feature we hadn't really registered or taken note of, once we take the time to look deeply? A freckle or the eye color of a person, or a tree or a shop in a park? To use a relevant cliché, we don't even know the back of our hands "like I know the back of my hand." Just as a word can be read without the brain processing every letter, so, too, can ideas or objects be recognized without being fully perceived and considered deeply in the psyche. We produce a general picture because we think we only need to recognize the generalities. Defamiliarization, on the other hand, aims at taking conventional language and shaking it up so that the referent isn't merely recognized or generalized in the mind, but instead is viewed again as something new, complex, and strange, something worthy of extending the perceptual process for.

A comical example of defamiliarization recently appeared in a simple online post: "*spins my clothes in a wet metal tube and then bakes them in a different metal tube to undo the wetness* [24]." This is recognized easily a description of one of the daily tasks in which many of us take part, doing laundry. But the language is unconventional; it's a new and different way of describing something we think we know well. The description makes you see the common as something strange, maybe wonderfully strange, in a way that conventional language just can't do. This can be comedic, like this example, or it can be deeply profound, such as Tolstoy's story "Strider: The Story of a Horse" [28], in which the narrator is a horse. The horse's view and the way he speaks about what he sees, and how he doesn't use the common terminology for events recognized by humans, makes for impactful use of defamiliarization. Humans reading his perspective come to see the word afresh.

To give a particular example, "your eyes are like the ocean" is an idea most of us have heard, which is metaphorical but has no real substance unless you're hearing it for the first time. This idea has died in the sense that it has become a cliché. Instead, a more skilled writer can say "your eyes are deeper than all the roses," as Gentner quoted from E. E. Cummings [12]. This metaphor doesn't map in a 1:1 correspondence between the tenor and vehicle, but it moves the listener; it makes the hearer reconsider and imagine. It makes us think about what that depth would look like, feel like, and imagine what the experiential resonance would be. Its feeling isn't just affect after all, but a perceptual expansion. It doesn't teach us something analogical, but it does teach us something refreshingly perceptual. It makes the known feel unknown again in a pleasing way.

Metaphors can be hyperlinks, making communication more efficient. But metaphors can also be a sort of slowing-down mechanism. Either way, there is a psychological benefit, a first-

coming-to understanding, or a reconsideration of one's existing understanding to realize that what's known is not nearly as known as it had been assumed to be. Both of these functions are important in their own ways in areas of academic work.

Seven: The Enriching Cultural Cross-Pollination of Metaphors

Even though there are risks and downfalls to cultures having differing metaphors—the cultures whose metaphors are publicized might be spreading not only their knowledge but their knowledge gaps, which can have severe effects—there is also great creative potential at work in the collision of these cultures and their unique metaphors.

First, although it's a shame that a culture's metaphors may have inaccuracies that mislead comprehension, collaboration between cultures can illuminate those gaps and make them visible. Once they're visible, those metaphors can be questioned, worked over, maybe even changed. A great example of this cultural confrontation is the daughter cells story from Arri Eisen and the Tibetan Monks. Cross-pollination of metaphors can also be effective in the realm of creative thought and understanding all of the work that a poem is doing, or that even a single word is doing as it calls upon its connotations, etymology, and more.

Daniel Bosch described a wonderful experience he had when he gained an understanding of where a word came from and its implications: "stanza," which comes from the Italian word for "room":

> **W**hat if you didn't know that "stanza" was the Italian word for "room?" Then you could never think about stanzas as being these rooms in a building, which is terrifying. How are you going to understand stanzas if you don't know that?... I was at a talk yesterday by a poet, Kevin Young was here. He was talking about writing poems in response to his father's death, which he did for a while, he published a whole book of them. And he was saying how… all of his father's side

> has been literally handled by the same funeral parlor at their death. And in the same parlor. So going back for generations, the Youngs' dead bodies have been in the same *room*. And he kept talking about going back to the same *room*, and I kept thinking about how, it's like a stanza for him. His family sings grief in this room, in the shape of this room. I had a lot more fun with what Kevin was doing and it was much more meaningful to me, and it ramified much more with my own thinking because of my ability to make that connection. (Bosch interview)

Bosch saw how a room could be a stanza for someone, a poem about their life, because he knew to take a word not just for its surface value, its temporal meaning, but to dig into its history, to find how it has evolved through a lifetime of wordhood, how it has been handed back and forth through cultures until it lost its room-ness for most of us English speakers.

Many people presume that a word is timeless; it means what it means. Instead, perhaps we should be thinking that a word means what it means, means what it has meant, and means what it will mean—that time and place are aspects of our language that we ought to consider, and that can be brought more to life by coming into contact by languages and words that have lived in other places, and other times.

Eight: The Snowball of Creativity Enabled by Metaphor

Daniel Bosch's discovery reinforces a point by Marshall Duke that the creative person isn't someone who stores away knowledge selectively, with knowledge of how it will be useful in the future. The creative person keeps ideas and knowledge in their head that can collide and connect naturally and unexpectedly. This could otherwise be thought of as learning for the sake of learning. This was the case with Bosch's knowledge of the etymology of "stanza," and his happenstance collision with a poet describing a room in which his family has so much history.

Duke has adopted metaphorical terminology to explain the difference between people who have thin knowledge, and the creative people who have depth of knowledge: "pancake people," and "muffin people." People who rely on their phones or other kinds of outside input for information (How many feet are in a mile? Let me just pull out my phone) are pancake people because their knowledge is like a pancake: "it just spreads out really far, but it's really thin." These people don't exist in the world with depth of knowledge because they don't have to do so. "Why learn to recite 'Trees' as a poem if you can just pull out your iPhone when you want it, right? Why memorize sayings… or important documents as people used to do, or tuck away information?" the mentality is that we don't need to know the information; we just need to know where to go so that we can find it. There are consequences to this way of living, though: a loss of creativity. According to Duke:

> **T**he result of this pancake-ness…because you don't carry a lot of information in your mind, you can't make unique connections. You can't say, "You know, Robert Frost is kind of like Pablo Picasso. They both…riff on these objects, and one would produce a poem and Frost would use a mailbox or a path in the woods, and Picasso would take something apart and put it together again." The internet will not do that for you. A search engine won't do it. (Duke interview)

Duke reported that his lived reality has changed as a professor since the internet has become so central: students have begun to write papers that all have the same ideas, the same citations. "If you google 'Picasso and Frost, I will get back pretty much the same list. This means that creative ideas are more difficult to come by if you are a pancake person. Because you are dependent upon something else to make connections, if connections are made at all." Thankfully, there is an alternative to being a pancake person, being a "muffin."

> **A** muffin top is wide, but underneath it there are some deep areas. My point was and continues to be, you need to learn as much as possible and put it in the same

> place. Without knowing why it's there. You can't say "I'm going to learn it because I need it for X Y or Z," because you have no idea why you are going to need it, and you have no idea when you are going to need it. (Duke interview)

Duke has conducted research on what it means to be a person who lives this alternative, storing knowledge in one's head. In creative people, many ideas have been emulations of being "muffins." Duke reports that in his research and courses on creative people, they'd look at the lives of creative people. Sure enough, they would find that these creative ideas arose because of all the interconnections that could be made out of what was already stored in the person's mind. "You can't connect stuff that isn't there," he said.

Metaphor, like creativity, is this process of identifying and filling out novel connections. It is therefore a birthplace of creativity, and an indicator of a knowledge-filled and idea-ready person. Metaphors allow us to connect ideas in our heads that have been gathered independently, to see a new forest in every coupling of trees, or a new constellation in each relation of stars. But each tree and star needs to be planted for its own sake first, before it can be part of a greater comprehended relation. Knowledge is not gathered for the purpose of creating the picture; instead the picture just emerges as a result, unpredictably, unprecedentedly, and this is the very thing that is lost as soon as information is no longer stored in our own minds but in our devices. The creativity, the new ideas and ingenious hypotheses, cannot come to life if we don't have knowledge stored internally that can collide and emerge with a fresh connection. Creativity and science require thinkers to have an in-mind knowledge base, not just an on-hand database.

Nine: Metaphor at Work in Verbs, Phrases, Extended Metaphors, Whole Stories

Before I talk more about the best work that metaphor can do in the nonverbal realm, I think it is worth mentioning all of the layers of the verbal world that metaphors can penetrate, which probably also expands beyond the general public's expectation.

If you think about the format of a metaphor, probably you'll think of it as a phrase within a sentence, a whole sentence, or maybe a couple of sentences. Probably, there's even a general understanding that there are "extended metaphors," which we can identify as being parts of a theme in a story. Sometimes a whole story, though, works as a kind of metaphor. Stories whose metaphorical structure is created for the purpose of teaching a moral lesson are called *allegories*. For example, "The Tortoise and The Hare" is a story about a race which teaches its listeners, often children, that slow but steady, committed work will pay off and "win," whereas quick but sloppy work that is uncommitted or sporadic won't "win." It's not just the outcome but the work ethic behind these behaviors constitute the lesson. Be like the tortoise, not the hare.

However, allegories aren't the only kinds of stories that can work metaphorically throughout a whole story. Kate Nickerson earlier mentioned that the Death Eaters in Harry Potter are akin to the Nazis; therefore, they're an analogical metaphor which acts throughout the story of Harry Potter as a power of hate, killing, and prejudice.

In his research and teaching, Michael Lucker addresses this idea of story-level metaphors in films. Characters in their roles or actions can be metaphorical. The scene of the main character in *Top Gun* throwing his father's dog tags into the ocean is a metaphor of him letting go of what he'd been holding onto and showing that he had felt wounded for a long time. The carrying and burying of the figurines in *Gladiator* is also a metaphor. These metaphors function at the story level, and for a metaphor to work at the story level, it can't just be in the words. It can be carried out in a nonverbal sequence of actions. In this way, the metaphor transcends the sentence and

becomes conceptual; it becomes narrative. Metaphors aren't bound to words but can be as big as thoughts, stories, as expansive as real life and the unspeakable, un-summarize-able.

However, metaphors don't only expand beyond the scale of phrases and sentences into whole stories. Analogical metaphors can be encased in single words, often in verbs. Dedre Gentner explained to me that she thinks of verbs as "basically little institutionalized analogies. It's the same relational pattern, and you just use it across different sentences." If a verb can be a little analogy, this means that our simplest vocabulary items, the slightest actions and items that we talk about, can be analogical metaphors. However, the significance of verbs being analogical becomes complicated. I had asked Gentner why, for children, nouns are easier to learn than verbs. This might be because children understand surface properties better than relational ones. Intuitively it seems like nouns are about surface properties, and therefore are easier to learn, whereas verbs aren't tangible but denote types of movements and actions. But nouns and verbs can't be broken up that easily. Gentner explains:

> **S**o indeed I have a paper saying why nouns are acquired before verbs and so on [15]. I think that research has held up very well. But, the nouns kids are getting are all concrete nouns or proper nouns; they are not getting nouns like "justice" or even a noun like "gift." But if they do, let's do "gift," because a gift is something that kids from a very early age are very interested in, and a concrete object is often a gift. The problem is, and here we go again with the relational meaning, they don't get the relational meaning. So they think a gift is a colorful thing wrapped up with a ribbon on it. And if someone says, "You may have that car," they don't recognize that that's a gift. (Gentner interview)

Many nouns aren't concrete. A gift can really be anything, it just depends on the context and what's happening. So, even a noun can't be fully learned due to its surface properties, which is important when we consider what it means to acquire language and the various parts of language. Taking the noun "gift" and making it the verb "give" also stimulates complications:

> **F**or my thesis, way back, I was working on the meanings of the possession verbs. And what I noticed is that they're incredibly hard. Even a word like "give," so you can give someone like five dollars, you can also give them a hard time, you can give them the best years of your life, you can give them a really great idea, you know on and on and on. Verbs very naturally end up being used analogically. We don't even notice that we're doing it. It happens very gradually for any given speaker. And children don't understand that. (Gentner interview)

Gentner explained that regardless of these complications, however, nouns may strike even mature adults as more obviously metaphorical than verbs do, as a general rule.

> **S**o if I say, "my surgeon is a butcher," you notice that it's a metaphor. Whereas if I say, "I gave her a great idea," you don't even notice that it's a metaphor. So there is a kind of asymmetry between verbs and nouns in this respect. (Gentner interview)

So, in sum, metaphors can be at work beyond the individual words on a story level like an allegory, or deeply at work within individual words and what category of word is being used metaphorically within a phrase.

Ten: Making Metaphor by Converting Nouns into Verbs

Many productive metaphors are made when a noun becomes a verb. We see this even in pop culture. We have an app, Snapchat, but eventually people began to say "snapchat me," turning the noun into a verb. This conversion easily creates new language that people can understand if both parties are familiar with the noun. Translating it over into the verb realm takes less work than coming up with a whole new word to remember as a verb for that function and for the particular need. The Snapchat example shows the making of a literal verb, and not a metaphorical one, which could be saying that someone who blended in "*chameloned* to the wall," for instance. There are many ways that we can productively create new verbs, which are

built from a sort of analogical mental process. We understand that even a noun carries with it a lot of information about the work and the actions that are involved around that noun, so it's easy to turn some nouns into verbs.

Eleven: Nonverbal Metaphors: Movies, Ads, Art, Monkeys

Story-level metaphors have been discussed, and something like color can become a metaphorical stand-in for emotions, like blue for sad and yellow for happy, or how Duke talked about how artists like Picasso can be great at metaphor in their work. Art, TV shows, and other kinds of entertainment hinge upon these nonverbal metaphorical links, and without them, we'd be at quite a loss in the humanities and the arts. A lot of the skillful examples of the principle *show, don't tell* wouldn't be possible. However, many other kinds of nonverbal metaphors should be mentioned: cross-modal correspondences often take on this non-verbal metaphorical aspect. We can think of a bright shirt as being "loud" for a music advertisement, or a tranquil forest as being "fresh" for a laundry detergent advertisement, or a plush animal as being "soft" for a fabric softener advertisement. These are all different kinds of transfers used in ways that elicit our senses. Metaphor can be cross-modal, between the senses, with no language required.

Another important place that metaphor's nonverbal attributes can work is in the thinking and the knowledge base of nonverbal animals such as monkeys. If metaphor must be thinkable before it is speakable, perhaps analogical metaphor is still thinkable for some primates although it is not spoken by them, at least not in the ways that humans tend to think about speech, and metaphor within that. Andy Kazama has found that monkeys can generalize and use their generalizations for reasoning. If they can think abstractly enough to comprehend what the "odd" object out of three objects is, this seems like analogical thought. Do they only have analogical

thoughts, or literal analogies, but not metaphorical analogies? It would be interesting to further investigate.

Twelve: Metaphor in Thought

As I have been arguing, metaphor is not just an act of language but an act of thought. Some metaphors never have to run through language, but they do have to be thought and organized in the mind. However, some of the ability to think metaphorically is helped by human language abilities. Once there is language for something, it gives more detail with which to think about it, a better way to keep track of thoughts and to organize them in relation to one another. Language is a catalyst and not the birthplace of metaphor. We know from studies such as those of Dedre Gentner that babies understand similarity, even if it begins with superficial relations, and these abilities grow as our experiences accumulate. We are thinking and connecting in this way long before we are language-ing, and all throughout the time that we have language, too.

Metaphor can penetrate just about everything, it seems, that involves thought. But what does this mean if metaphors are not always doing something beneficial or accurate? What is the size of the mark metaphor can leave when it misleads, confuses, or even brings damage and prejudice into the world?

THE WORST OF METAPHOR

Of course, metaphor can also have its dark side, if it is used poorly or if it's used for the wrong reasons. Before getting into the findings, it's a good starting point to again consider the criteria for an analogy laid out by Dedre Gentner, and how these points being violated can result in a bad metaphor. What happens if the answer is "no" to any of these criteria:

- Is it structurally sound?
- Are the inferences true (factually correct)?
- Does it fit my communicative goal (are you getting the desired inference)?
- Does it have the right valence?

Not only can a metaphor be poorly formed if it violates these criteria, but more types of violations can result in a bad metaphor, as will be discussed in this section.

One: Inaccurate and/or Misleading Metaphors: Domain Choice and Valence

One of the core findings of this study includes identifying existing metaphors that are in some sense misleading and yet central in academic settings, such as the *mother and daughter cell* metaphor, which is so widely incorporated into biological science. The main point of the mother-daughter cell metaphor is to talk about generation of cells, and as long as it's understood that one cell replicates its parts and it divides into two cells, maybe the *mother and daughter cell* metaphor works. However, if we are trying to understand what cell life or death means in that scenario, we're in trouble. The facts of the mapping are limited. It's a representation, not the reality. One cell doesn't birth another cell (or two others) and go on living, but instead, one cell doubles its interior pieces and then breaks into two. This isn't the same as human mother-daughter relationality. The metaphor creates limitations through its mapping and the way makes us conceptualize cell replication.

A metaphor can also be inaccurate or distorting if the valence misleads. If someone had no idea what poetry was but they were given the poet : poetry :: terrier : rat analogy from poet W.H. Auden, how many might take the valence of a rat being a dirty animal and attribute that feature to poetry, thinking of poetry now as something at which they should turn up their noses?

If we persist in the metaphor about cancer being a war, how does the mapping do a disservice to some terminally ill patients who would be better served by a different story, one that won't tell them that to die would make them the *loser*? (This is the argument made by Susan Sontag, the author Garland-Thomson mentioned.)

Quite quickly, the issue of metaphor becomes ethically complicated. We may do a disservice to concepts or experiences all the time if our metaphors are incorporating examples whose valences are unfitting, or if our metaphors are constructed with intentionally strong valences to make something seem better or worse than it actually is. Dedre Gentner addressed the relevance of this issue when it comes to politics:

> **S**o for example, political analogies. When someone is writing some article trying to persuade people of a certain position, they choose analogies that are from pleasing domains to match with their own position, and they often choose mappings from the yucky domains to match with the other guy's position. Because we know that even though in a sense it's only the structure that matters, people always care about the objects as well, especially about their valence. So, that's the next thing to look at. Have I put people in the right frame of mind to either love or hate what I'm trying to tell them? (Gentner interview)

If the people in power know that they can use this transference of meaning to make themselves seem better, or the things they disapprove of seem worse, many potentially unfair outcomes can result. These kinds of metaphors can be seen not only in politics but in the news. When metaphors go awry, then public policies, animals or forests that need protection, groups of people who are struggling or succeeding, anything can be painted into an oversimplified or unfair way, swaying public opinion and even votes. All of this influence occurs not because of data or facts, but because of metaphors.

Two: Inaccurate and/or Misleading Metaphors: Degree of Extension

Sometimes a metaphor is accurate to some degree, but if its relations were to be extended further, issues might arise. Taking a metaphor "too far" was an issue Gillian Hue and Dedre Gentner addressed. There may be aspects of a similarity that work in constructing a new understanding, but if something isn't literal, its useful scope is limited.

If I say that my morning coffee is like a warm hug, I am conveying that it is comforting, warm, enjoyable. However, you probably know that the meaning stops in that the only part of me touching this coffee is likely my mouth (and eventually my stomach), and in some sense also my hands in that they touch the warm mug, although that's not me directly touching the coffee. If you hear this metaphor, you don't expect to make coffee and have it give you a full-body embrace. If you know about coffee, you know that this isn't an extension to make. If you are being taught something new, however, you might not know how much of the first domain to map onto the second. What seems silly to an expert may seem acceptable to the novice or the trusting mentee. What happens when a mapping goes too far?

In linguistics, this is a very real problem when one considers what language is. Sid Horton explained the limitations of a common metaphor he hears that likens language to a conduit, or a direct channel where something just goes from point A to point B, or as he puts it, the conduit metaphor conveys that "the ideas that language itself... acts as just a communication tube." He says this metaphor falls short because communication "involves the people, it involves the knowledge, it involves the background." For example, we only use the word "that" or "it" if the speakers share a knowledge of the referent.

The conduit metaphor conceals the facts that language doesn't produce self-contained messages, and that language involves higher-order issues such as pragmatics. Tone of voice,

fluency, irony, generational knowledge and experiences, and common knowledge between speakers are not as simple and straightforward as a conduit. Language is something more complex, but the complexities provide opportunity for greater understanding, wonder, and better scientific questions to ask about language. If language were merely a conduit, these other aspects wouldn't matter and couldn't be studied. All of that, lost at the hands of a metaphor that can only represent a very limited amount of information about what it is talking about. Knowing how far to take the mappings of a metaphor, and when to drop it, is essential.

Three: Context and Knowing Your Audience

Gillian Hue told me about the importance of knowing her audience when she is using a metaphor to explain something. As a lecturer who teaches neuroscience to three unique groups, undergraduate neuroscience majors, undergraduate students who major in other areas, and Tibetan Monks, she has to ensure that her methods of explanation are sufficient in each of these contexts. Hue offered examples about how knowing her audience has affected her metaphor use, and the examples she uses. Always, she considers how her metaphors and examples would work in relation to the cultural and generational context of the students. She used to incorporate examples from movies and TV shows such Seinfeld, to which her students no longer respond because these students aren't watching Seinfeld anymore, as previous students did. She realized her examples could fall flat due to differences in cultural knowledge, such as knowledge about sharks.

In one instance, Hue was teaching Tibetan monk students about structure-function relationships in neuroscience, for which the chemical senses, such as the olfactory (smelling) system, are a great example. A translator was putting her words into Tibetan so that the students

could follow along, and her planned example was about the sense of smell in sharks. Once she said "sharks," her translator stopped, searching for the word for "shark." She realized then that her whole example was going to fall apart—surely if he wasn't sure of the word for shark, neither he nor the other Tibetan monks would relate to this idea of "a drop of blood in the water" that her students at Emory always caught onto so quickly. This was a kind of story that couldn't "plug in" because it lacked the necessary cultural relevance. "They're not watching *Jaws*," she said, "So I was like, this is not going to do what I think it should do. I'm going to be trying to teach a concept in order to teach a concept. And that doesn't make any sense." She reflected that her North American students, or her Jamaican students (Hue is from Jamaica originally) would immediately pick up upon the shark and "drop of blood in the water" idea. This just wasn't the case for her current audience of Tibetan monks. "What catches," she said, "depends on your audience."

If a professor or even a person in a common conversation forgets about or is unaware that their referents differ from those that their listeners have to draw upon, that can create confusion. If a metaphor is drawing upon ideas unfamiliar to an audience, it can't teach the concept. Awareness of the audience should affect how information is communicated, and what metaphors are crafted to give examples.

Four: The Malicious Side of Metaphor: Prejudice and Oppression

Because metaphor is embedded in our thought processes, and because metaphor is an act of comparison, it can give us new perspective… but not always an accurate or helpful new perspective. If a metaphor is misused in certain ways, the new perception crafted can be one of prejudice.

Although all of my interviewees spoke lucidly about how metaphor could go awry in its "worst" forms, a great deal of insight about the ethics of metaphor came from Rosemarie Garland-Thomson. She helped me to see how bad metaphors not only muddle school-centered knowledge but can breathe prejudice into our lives and result in real-world consequences as big as reinforcing systematic oppression. She has been a central voice working in the field of Disabilities Studies for decades. Her work shows how some supposed "dead metaphors" carry a dark history of terms formed to talk about groups of people who have been systematically devalued, marginalized, and even publicly regarded as freaks, and discrediting terms such as *idiot* and *lame*, as I mentioned earlier on page 30 with quotes from Garland-Thomson.

These examples of dead metaphors like *idiot* and *lame* complicate the idea of a dead metaphor. Does the history of "blockbuster" resemble the history of "idiot," or are they both irrelevant? Or should we remember the foundations of terminology that has participated in oppression and extract it from our language because of what it has meant and the traces it still carries with it?

It isn't just individual words but systematic themes of metaphor that can cause harm to groups of people. Consider the metaphors that frame cancer. Although in general, patients with cancer are regarded positively in that they are called "fighters" and "brave," some patients with cancer have disliked or even been harmed by the cancer as war metaphor, as Susan Sontag argues in *Illness as Metaphor* [25] after she comes out of her cancer treatment.

This issue is also recognized by the doctor's perspective in Atul Gawande's *Being Mortal* [16]. Gawande addresses cancer and other terminal treatments and proposes that taking a "fighting" course of action does not always yield the best end-of-life process for a patient. Many people don't know what to do when handling an experience such as cancer, especially if the

prognosis is certain death. As grim as it may seem to say bluntly that the diagnosis is terminal, Gawande writes that sometimes it's grimmer to watch a patient "fighting" until the end, enduring treatments that just take away quality of life and sap the patient's strength, without actually slowing the cancer's traction. Inaction or reduction of action may sound like giving up. But, as Gawande argues, sometimes letting an illness play out and providing palliative care to enjoy better last days is much better for the patient, at least better than spending their last days in a slew of miserable treatments in which the patient is too exhausted or drugged to be aware of attentive friends and family. Ironically, sometimes patients in hospice outlive those who go into experimental therapies and risky treatments.

Why are unfitting aggressive treatments so prevalent in medical care, with cancer and other illnesses? Our conceptualization of medicine, at least in the West, is probably to blame. As Garland-Thomson puts it: **"**Because it is the enterprise of medicine to identify and eliminate disease." A metaphor then begins to drive a whole cultural attitude, and many end of life decisions that are undesirable or later regretted, as with some of Gawande's patients.

Of course, this is not to say that for some patients, the "war" language isn't helpful. However, this metaphor is crafted with an imbalanced benefit, boding better for those who have types of cancer that can actually be "beaten" (or more literally, *cured*). Of course, *cancer is war* isn't a universally unhelpful metaphor, but it also isn't universally helpful. For patients with unavoidable terminal diagnoses, this metaphoric framing of *cancer as war* may contribute to a more painful end of life process, when a peaceful end without as many tubes and trepidations could have been an option. All this, from a metaphor.

If there is anyone left who thinks that the danger of metaphors doesn't pertain to them, you're still vulnerable to metaphor if you live to be elderly. In the introduction of her book,

Extraordinary Bodies, [17] Garland-Thomson addresses the many kinds of diseases, illnesses, and disabilities that can exist in the world, including mobility impairments, cognitive troubles, and acquired diseases. If a person lives long enough, though, they will become debilitated by old age and its various losses and difficulties. Understanding disability and the way it pertains to people in all walks of life, in all forms of being, is imperative. Our metaphors affect the ways we treat one another, and the ways we seek and accept treatment from physicians.

Issues of gene editing also come into play at the intersection of metaphors, disability, and ethics, an area in which Garland-Thomson has also begun to work. Recently, Garland-Thomson has earned a degree in Bioethics, and she has published an article on the dangers of gene editing. In her newly published article, "How We Got to CRISPR: The Dilemma of Being Human," Garland-Thomson says that, "To translate the unknowable to the knowable, genetic science offers us a metaphor to comprehend what it has observed about human inheritance: the computing machine," and this is where the flawed idea of gene "editing" came from [29]. Her article analyzes how the limitations of human perception such as perceiving CRISPR as a tool that edits in the same way that a Word document does can misguide the way we understand how something really works. According to Garland-Thomson:

> **W**hat I'm trying to do…is call attention to linguistic expression and word choice, which has both a narrative and semantic element to it, and how that does work in the world in order to make us think about the human variations that we think of as disability, and how that cultural work of language…gets work done in the world, and what it does.

An outsider might initially hear about the example of gene editing and think, with gene editing, aren't we just eliminating types of suffering that might not have to happen, and making a healthier version of the same person? It turns out that this idea gets much more complicated as we zoom in and see what is being called a disease, and what types of people are being

discriminated against and even eliminated under the name of "disease." One example given by Garland-Thomson is the metaphor of "retardation," a classification which derives from a metaphorical idea of how fast an idea travels in the mind, as if ideas and the space in the mind were physical, spatial entities. The term rests on the premise that the speed of such thought-travel can be normal or slowed, or "retarded." Populations of people under this classification, who are understood as having retardation, are being classified as suffering from diseases, which is then making them in danger of being edited out of existence. Garland-Thomson explains:

> **T**ake "retardation," that metaphor … we could say is responsible for the development of the first genetic test that was used in the reproductive testing economy to identify the kinds of people in the world that are understood as having Down syndrome, for possible selection and termination. Because those human variants are understood as disease…90% or more of the fetuses identified as having a risk for Down syndrome… are selected against, and not brought into the world. Now this is very controversial. In my view, it is straight up eugenics… Iceland has just announced that they are on the brink of eliminating Down syndrome as a disease. (Garland-Thomson interview.)

To highlight the critical issue here, the concept of "disease" is being used in a way that is surprising, if not shocking, because believing in retardation or conditions such as Down Syndrome as a disease means targeting a people group that isn't obviously suffering. Individuals with Down syndrome typically have a rather happy disposition and an ability to live full lives. So how and why are people choosing not to bring fetuses with Down Syndrome into the world? According to Garland-Thomson:

> **N**ow that's the work of disease… a lot of people think that's exactly what we want to do, that getting rid of Down syndrome is the same thing as getting rid of polio. In my view it's not. But you have to be able to lift away the understanding that all of these characteristics of these people are all diseases. It's quite astonishing how normalized that has gotten to be, and how corrosive the conversation around that

> is in the United States… people who have family members with Down syndrome call into question the eugenic element of this. It's hugely controversial, and almost never questioned.

Importantly, the ones who are best acquainted with people who have Down Syndrome aren't advocating for its elimination; they don't want people like their loved one(s) with Down Syndrome to be selected against, which is probably not the response that would be coming from a family whose loved one has polio. Is it the label of "disease" and not the actual experience of this type of person that is allowing them to be discredited and eliminated on a global scale? As Garland-Thomson mentioned, whether Down Syndrome is a disease is a highly controversial issue, which quickly becomes political, not just semantic and conceptual. The issues involved in gene editing are vast.

The importance of the language used when the topics are biology and ethics is something in which Arri Eisen also believes. He had pointed out lucidly that "the language we use drives the next experiment." Metaphor-driven scientific and medical campaigns affect real-life issues such as the way we waged a "war" on bacteria before we knew that there were also good bacteria on which human life depends:

> **W**e created antibiotics in WWII, and instead of getting a cut and dying, your life would be saved. What we didn't know… that we were killing all these other bacteria that we're filled with, bacteria to keep us alive and have evolved with us for millions of years. That are essential to our survival as organisms, as thinking, things that digest food, [to] have immune systems and think… now we know that most of the diseases in the West that are killing us in the west are diseases are probably to some extent due to us killing all of these bacteria. How ironic is that? (Eisen interview)

Eisen contends not only that our conceptualization of bacteria in the West led us into this mindset of eliminating bacteria. If a Buddhist had discovered bacteria, however, and they had

seen how it can be a "disease-causing agent" they would have "tried to adjust the ecosystem… so instead of just killing the bacteria, other bacteria might suppress the bad bacteria… we could fiddle with the ecosystem, but not kill them in ways that would wind up having these disastrous effects…Then all of history would have been different."

What can we do to mitigate these disastrous effects of one culture handling a problem in a way that another might not have handled the issue? Any group of people is likely to make a mistake, to have some kind of bias or misconceived plan of action when information is lacking. In this example, it seems that the Western scientists made a pretty big mistake. Eisen ties the attitude toward bacteria to the way we in the West have handled cancer treatment:

> **I**t depends who discovers, who asks the questions, who funds it... And cancer's the same way. We've been trying to kill cancer cells for God knows how long, ever since we discovered it. And all the language is "a war against cancer," and all the language was just like with the bacteria. (Eisen interview)

These points bring with them many important issues to be conscious of, and people who need to be respected and protected in both our policies and our language. Unfortunately, there are yet more groups of people who are systematically discredited by misuse of metaphors. Kate Nickerson mentioned how metaphors have brought offensive, sexist language into the classroom:

> **S**tarting in the 1990s, there was a very bad idea to use sexual metaphors to get across points. So here's a very famous one… I still hear it sometimes today and I'm totally pissed off and shocked about it… when a student asks, "how long should my essay be?" They say, "it should be like a woman's skirt. Long enough to cover the subject, short enough to be interesting." And that's been used since the 1940s… There are plenty of ways to explain how long an essay should be without resorting to this sexist, sexualized garbage… And your paper is not supposed to be a flirtation. It's something else. (Nickerson interview)

Nickerson explained that these kinds of statements may be used because the teachers want students to remember what they're saying. Plenty of offensive, dehumanizing events and ways of speaking have been *memorable*, but that doesn't make those ignorant acts permissible. Uncalled for, sexist language like the metaphor Nickerson pointed out as outdated and unfit for the classroom is still unfortunately used by some educators, which is of serious concern. Traces of how groups of people have been dehumanized or objectified appears in the unprofessional, unenlightened language that some teachers think that it is acceptable to use.

Nickerson also discussed a metaphor that actually does not derive from a discriminatory background, but due to how the world has changed since the 1800s, it quickly comes off as discriminatory. The metaphor is, "the pot calling the kettle black." According to Nickerson:

> **I**t's supposed to mean, "don't criticize people for things that you do also, or that you are also." So a pot would be blackened [from the stove] and the kettle could be blackened from the stove. But, there's a whole other weight of metaphor on top of that about skin color and race… I think sometimes there can be miscommunication because… you know a professor might use it quite innocently, it's an old saying that goes back into the 1800s, whereas a student might be quite offended. (Nickerson interview)

The effect of such a situation arising in the classroom from an out-of-date metaphor can be quite understandably detrimental. Not only might a student take offense, but the possibility for learning and a relationship of trust between teacher and student could disintegrate. Whether or not the root of the metaphor was discriminatory, the current context gives the words a certain interpretation that isn't worth risking or dragging into the classroom. Nickerson described how using a metaphor that offends can make some people feel unwelcome, and it can stop students from being able to learn or to feel safe and respected.

From the perspective of a psychologist, Duke commented on how the choice wording of a metaphor can change how the tone is interpreted. Choice wording may give offense between any two parties, especially in conflict. Duke explains that:

> … [You can say] a conflict, vs. a disagreement, vs. a kerfuffle. "We grated against each other like rocks," vs. "we rubbed each other the wrong way." You know what I mean? I think the "battle" or "wartime" metaphor is common, but also it is softer when we have… "Chess" is a common metaphor, when you have "intellectual combat." (Duke interview)

Not only the type of metaphor used but the connotation of the intensity or valence of a metaphor can have an immense effect: a conflict, disagreement, or kerfuffle all send a very different kind of message, framing what the literal or exact conflict is in ways that make it seem straightforward, less oppositional, or even a bit humorous.

Certainly, the damage that metaphor can do in terms of spreading prejudice is significant, whether its driving discriminatory action occurs in science, creating offensive divides between educators and students, or using common terms that draw from a history of oppression and involuntary sterilization of disabled individuals.

Five: Isolating Cultures with Their Own Metaphors, vs. Inter-Cultural Collaboration

With cross-cultural collaboration, groups of people can symbiotically enrich each other. Getting this kind of fresh pair of eyes on systematic metaphors can help a people group become defamiliarized to their own systematic language, as Arri Eisen experienced. But what is at stake if metaphors aren't discussed cross-culturally? Can a person from one culture even fully "access" what a metaphor means to a different group of people from a different context, even in a totally different time period? Daniel Bosch contemplated this point in talking about one of his favorite writers, Roberto Calasso. Calasso would read and translate ancient Indian texts, many of which

were in Sanskrit. Bosch said this with regard to the question of whether a metaphor retains its essence across translations:

> **I**t seems that I cannot possibly have a valid accurate experience of an ancient Sanskrit metaphor when the objects that are used, the names of the objects that are used to convey it, for instance, don't mean what they mean to me…. But sometimes, at least in Calasso's hands, it seems that I do… I think a lot of translators allow themselves native metaphors. If I'm translating into English and I'm looking at something from Sanskrit, and I can't match it…I should probably try to come up with what I think is an approximate English equivalent… The chapter of the Calasso book that I was reading is called, "meters are the cattle of the gods."…I don't think I have access to whatever word they used to convey this species of animal that Calasso has translated this way…But I'm still so delighted by this idea that the gods have cattle. And that the cattle that the gods have are the meters. (Bosch interview)

Bosch said that this kind of translation experience is like what Wallace Stevens means when he says "poetry is the supreme fiction." That translation is a type of supreme fiction, an "unfathomable fictional realm I have just entered into." He also brings up the point in that across languages, words sometimes don't have perfect equivalents, and we must draw approximate connections. Would we have so many translations of a book like the Bible if translation were an exact science? Just a few words or orderings of terms can greatly alter meaning.

It is important and worthwhile to respect but also to engage with other languages and consider what they mean, and how translation functions in their space. If later generations don't interact with authors who came before them and assess their ideas, the newer generations will be deleteriously in deficit. It's not the imperfect mapping of meaning across languages that is the danger, but the failure to attempt communicating about meaning between cultural groups, trying

to inch towards greater accuracy and understanding what others mean when they speak an utterance or think a thought in a particular way.

Arri Eisen talked about the art of translation in his text, *The Enlightened Gene* [23], and I asked him if he felt that the impressive turns of phrase of a translator involved their ability to work with shuttling both literal and figurative translations across languages. He said yes, because the particular translator he has worked with, who was studying to be a monk and is Tibetan, "knows the way that monks think, knows the way that secular Tibetans think, and then he came to Emory…. And learned English…. So he learned science-English and regular English. So he has all of that, and a cultural context of all of those." Eisen said that because this translator knew the cultures and contexts, the various types of language and systems of language even within a language (regular and science English) it gave him assurance that the translation process and what was being communicated by this translator were what they needed to be. These incongruences between metaphors and literal vocabulary items were an enhancement and did not detract from the translator's work. Eisen explains that:

> **E**ven though I can't understand what he's saying, it's very clear when he translates the science that we're teaching, the richness of it is very different and the understanding of it is very different. I would guess that… because of all that, he has a greater appreciation for… all how those different metaphors interact and which ones to access in which instances. (Eisen interview)

Of course, the English speakers and the Tibetan speakers differ in terms of their words and their translation equivalents. But also, these groups differ in how they handle learning new ideas and how they incorporate those ideas into their own languages. To build an understanding of the science that Eisen was teaching them, instead of taking a near-fitting translation equivalent, the monks would *make* new words:

> **T**ibetan Buddhism has a long tradition of creating in order to understand their world, trying to understand everybody else's…. Not just saying "mitochondria are mitochondria, spell that in Tibet" but thinking about what mitochondria are in the context of their metaphors and language and creating a new word for what mitochondria are. (Eisen interview)

In the Emory Tibet Initiative, they have built 5,000 words through this process. One could imagine that this way of seeing other languages creates a different kind of learning process and perspective on what it means to adopt a concept from another culture.

Without textual and conversational cross-pollination of metaphors, terminology, and ways of thinking, how many ideas and how much knowledge would be spurred? How much knowledge are we already missing out on by not engaging the metaphors that one culture has with the metaphors of another? We should learn to see our terminology and our figurative language as in some capacity reflecting a reality, but also be aware that this reality exists within a specific context, of a specific time period, of a specific set of decisions made by that culture on how to speak about their ideas and experiences. The conversation between cultures about how we talk about ideas, be they in poetry or science, would help us to see more of how the way we talk about things matters.

Another place to consider the potential difficulties in cross-cultural talk, with metaphor and literal language, is when a phenomenon is well recognized in one culture but not in another. How can the two groups know they're talking about the same thing? This is the kind of work that Eisen is studying as part of the Emory Tibet initiative in investigating whether monks get depressed:

> **W**e have been bringing together undergrads, psychiatrists, nurses, doctors, religion scholars, translators… to look at this question…of course immediately we get all kinds of complicated problems. So what does it mean to be depressed?

> What is depression? It's a very kind of Western medical concept, and if you want to ask a monk who doesn't speak English if they have depression, you have to think really carefully about what words you even use to ask them. Then much less if they get depressed or what it means to get depressed. (Eisen interview)

He concluded that the hardest part of a project like this is trying to take your own knowledge and experiences as a teacher and "translate them into many different minds and experiences and backgrounds," and whether you're learning about depression in Tibetan monks or teaching biochemistry, that is the most difficult thing to do. We have to consider how others think before we try to give them our own thoughts and knowledge. Similarly, how we think needs to be considered by our teachers who wish to teach us something new.

Six: The Danger of Overused or Clichéd Metaphors

Even if it isn't a medical danger, default and unoriginal metaphors pose a very real kind of danger. When it comes to poetry and literature, default or clichéd language is something to be avoided. If poetry is supposed to be an act of creation, how can one claim to be a poet if one is speaking in clichés and echoes of the general public's language? Why try to publish something in your name that has already been said, that doesn't add anything new or refreshing? The point that Daniel Bosch makes about clichés and stock language is as important to scholars of literature as to practitioners of writing and poetry. As seen on page 45, he says that students often use "filler phrases," but these "common failures are really just opportunities." Poetry, he says "needs to be imaginative," and using stock phrases is easy and reflexive, perhaps mental-energy efficient, but not imaginative.

It sounds as though seeking original language is where a lot of the learning happens, when a student turns something "flat" into something "spikey." Bosch explains:

> **Y**ou know I use this metaphor of spikey versus flat. I say that prose is flat and then perturbations in the flat are likely to be the most desirable [locations] of "metaphoric" or "ordinate" or "different" figures. I find this a very powerful way to think, and it involves a hypothetical flat-line. I'm not sure there is one, but in order to think through this…you have to kind of posit the flat-line…Then any perturbation in the flat-line is a possibility for metaphor… metaphor being "transfer" first of all. . . . So I mean basically [all forms of figurative language] are metaphor to me because they are all opportunities for transference of and comparison. (Bosch interview)

When asked if a lot of the learning about how to write poetry happens in learning to create spikey lines instead of flat ones, he had a "yes, and" response:

> [Also] doing a lot of reading hopefully to realize what's flat and what's spikey. You have to acquire a sense of what has been done before. And the degree to which I am telling them is terrible. I mean eventually they have to have their own taste and their own sense. (Bosch interview)

As confirmed from the viewpoint of a practitioner, it makes sense to say that the danger of bad poetry lies in using "flat" language, ways of thinking and speaking that are overused and lack the creativity that a poem is meant to encase, in order for it to have the kind of living heartbeat to make it memorable, meaningful, something worthy of being called a work of art. To do so, being familiar with the work that has been done already and what has made it new or different, and connecting new ways to do something uncharted, is essential.

Without fresh language, we are in danger of losing the essence of poetry. Poetry can take many forms, and one of the most wonderful and frustrating parts of poetry is how elusive its rules are. Some of the best poets and poems exist because of the rules they have broken. However, they have done so imaginatively, creatively. If we are willing to forego creative language and to cease wording ideas in new ways, combining new images, we are at risk of losing poetry… this is a very real and terrible danger.

Seven: When Metaphors Are Confusing

Sometimes a metaphor just doesn't make sense. Probably, then, it won't stick. Of course, this means that confusion can result in a lack of knowledge. In schools, this is exactly the issue that teachers want to avoid. They want the information to stick, but it can't if the examples don't make sense. Andy Kazama expressed this problem succinctly:

> **T**hings that I don't understand I usually forget fairly quickly. But for sure I have been exposed to [metaphors] I have later questioned, like wait, that isn't consistent with how we should be thinking about this. (Kazama interview)

Eight: The Risk of Metaphor

It seems we have come to an impasse between metaphor and literal language, which Kate Nickerson stated after she engaged in the exercise of explaining a phenomenon in literal language instead of metaphorical language. Even though it was slower and harder, she did quite well, producing a concise definition of a "femme fatale:"

> [Literal language] might be clearer to more students… My version of a rebel might not be your version of a rebel. So simpler statements might actually be more effective. They might be less vivid, however. So I think that's the tradeoff. The complexity of a metaphor carries a lot of meaning, but it also carries sometimes meanings that are misunderstood or carry other meanings you didn't intend. (Nickerson interview)

In tandem with these comments, Joe Le Doux spoke on how the risk of metaphor lies in its possibility of leading students unwittingly into incorrect or limited comprehension:

> **T**he worst case would be if somebody maybe said, "Oh yeah, that makes sense," and is satisfied with it, but [they] actually come away with a misconception. And

> maybe they use that in the future and confuse other people, and it might propagate… like a virus! (Le Doux interview)

Nickerson and Le Doux state in a nutshell what Dedre Gentner has found. The structural alignment of a metaphor can be powerful if it elicits the right inferences, and if those inferences are true. But engaging in metaphor is *risky*. The possible losses and payoffs are greater than those of literal language. Literal language may be more difficult to understand sometimes, and yet sometimes it may be more straightforward. Will literal language stick? It's hard to say, but it at least leaves less of a possibility of misleading or creating wrong inferences. Engaging in skilled, informed metaphor, rather than just engaging in metaphor for metaphor's sake, is important.

The WORST of Metaphor: Summary

The greatest dangers posed by metaphor fall into many categories. There is the possibility of building false or fractured understanding; speaking injustice and prejudice; or creating cultural isolation. On the whole, many forms of dangers and risks can emerge from metaphor, from poor-quality literature to continuing to speak a narrative of oppression to classes of people. The good news is that awareness is the first step to combating the problem, and hopefully, keeping these dangers in mind can help us to avoid the missteps that are possible, and can allow us to offer kind but enlightening knowledge to our peers, so that we can work together to emulate accurate, creative, and wise metaphor use.

UNEXPECTED FINDS: THREADS FOR FUTURE DIRECTIONS

By the end of any research expedition, the investigator should recognize not only what they have found, but what ought to be further explored. This has been the case for the present project.

In terms of the most natural future directions, more interviews of this kind with professors from other universities and other fields would help build a basis of understanding how metaphor is viewed and used at differing institutions, and in differing fields. Also, future directions could aim at interviewing educators who don't believe that metaphor is important for them or for their fields, as to diversify the sample more and to get opinions from people who directly oppose the stance behind this work. Also, to interview teaching-only or research-only professors or people trained in academia but who may work in other contexts, could be of interest.

Beyond the ways to directly extend the work, I discovered two unexpected questions to pursue in future studies: the relationship between metaphor and ethics, and the relationship between metaphor and narrative. I believe each of these topics has not only interesting outcomes but real-world value in helping to alleviate kinds of suffering and difficulty.

Unexpected Finds: Metaphor and Ethics

As soon as we start thinking about the ethics of metaphor, we find ourselves in deep water. The proposition here is not to police the language that people use, making for a dystopian world where free speech is impinged upon. Instead, being ethical about metaphor should be about enlightening people. It's changing the system through changing perspective. If the language is forcibly changed but the speakers don't know why, the meaningful change hasn't been done, just a surface change.

Ethical issues come to the table when representation has gone off-key. Although metaphors can reduce something to a representation of itself, sometimes we need to create these smaller, packaged versions of things in order to be able to talk about them, compare them, and do new work with them. It's better to have a way to create representations of reality than to have no interface with these elements of reality. As long as we keep in mind that we're working with representations, as long as we make an effort to stay in touch with what the realities and actual referents are, we're okay. This awareness of representation means making a practice of being mindful of metaphors, both our own metaphors and those of our peers and the experts in each field of study.

One area of research where I hope to expand this work is in the ethics of the metaphors for medical phenomena such as pain and illness. Previous research has shown that the metaphors used by pharmaceutical companies in their ads differ when they are trying to sell to patients directly to the public versus when they are selling them to health care providers, depending upon what kind of metaphorical framing to which that group is sensitive [18]. It isn't just the advertisers who use different metaphors for patients and doctors, of course. Patients and doctors themselves talk in different systems of metaphors about issues such as illness. Studies have found that physicians often use metaphors such as *patients are customers*, *illness is a puzzle*, and *the body is a machine*, whereas patients most often use metaphors like *the body is a container for the self* and *illness is beyond description* [19, 20]. In an experiment conducted on the *patients are customers* metaphor, it was discovered that when patients are asked about their "satisfaction" with the care they've received, their reports become more about hospitality and the accessibility of the cafeteria than the outcome of the healing of their bodies—with which they may not be satisfied [19]. Also, in the introduction, I mentioned a paper which guides health care

professionals through how to talk about nociceptive pain to cancer survivors, and these descriptions are riddled with metaphor [7]. Doctors and patients need to know that metaphors for pain and illness matter, for empathy and treatment purposes. If this kind of research is conducted, patients and physicians can better learn how to work together to make more informed decisions about the treatments and medications chosen.

If the language that patients and physicians are using could be found and shared with both parties, so that they could understand each other's ways of thinking and speaking, communication would be improved. The obstacles present in connecting a patient's and a doctor's feelings, desires, expectations, and possibilities may not be perfectly removed by understanding each other's metaphors and the thoughts and hopes behind them, but some significant obstacles in the relationship would surely be reduced. Meeting one another in the middle is the goal, not setting up camp solely with one side's terminology. However, this conversation could lead to new discoveries and new systems, such as perhaps finding better communication tools than the 1-10 pain scale, lamented as subjective at best and absolutely useless and problem-causing at worst.

All in all, the ethics of language with metaphor can be a place where a great deal of real-world suffering can be paid attention to, and perhaps relieved. It is important for patients not to be unheard and isolated, which can happen when they're not listened to or if they are only listened to for technical terms and not the experience and feeling of the suffering that metaphors can communicate. This is a feeling that people in chronic pain often experience, and many other kinds of patients. To help these patients to feel heard and seen as human beings is a goal of my future work.

Unexpected Finds: Metaphor and Narrative

The second finding that arose unexpectedly in this study is how narrative is imperative in many ways, and narratives by nature typically have some kind of metaphor involved. Narrative arises when interrelated information concatenates, be it personal events or the tasks completed by a cell or by a set of fictional characters. It's natural for humans to create a kind of knowledge-story. I also found that narrative was valued and incorporated by many of my interviewees: of course, the English professors all work with stories, but even in biology, Dr. Hue called her teaching philosophy "storytelling and compassion." Narrative also arose in Eisen's storytelling in *The Enlightened Gene*. The importance of narrative connects with works by doctors and researchers with which I believe a background literature could be drawn for this future research.

In *Being Mortal*, Atul Gawande addresses how people are wired to experience their lives as stories, even the story of pain throughout a medical procedure:

> **T**he brain gives us two ways to evaluate experiences like suffering—there is how we apprehend such experiences in the moment and how we look at them afterward—and the two ways are deeply contradictory. The Nobel Prize-winning researcher Daniel Kahneman illuminated what happens in a series of experiments …researchers gave the patient a device that let them rate their pain every sixty seconds on a scale of one (no pain) to ten (intolerable pain) … At the end, the patients were also asked to rate the total amount of pain they experienced during the procedure…
>
> Our natural assumption is that the final ratings would represent something like the sum of the moment-by-moment ones…But this wasn't what the patients reported at all…ratings were best predicted by what Kahneman termed the "Peak-End rule": an average of the pain experienced at just two moments—the single worst moment of the procedure and the very end. The gastroenterologists conducting the procedures rated the level of pain they had inflicted very similarly to their

> patients, according to the level of pain at the moment of greatest intensity and the level at the end, not according to the total amount. [16]

When it comes to the experience of pain, it's not about the objective, mathematically calculated scale; *it's about the story of the scale*, the pain's evolution over time as an experience. A perceptual, memory and story driven outcome. (Again, the 1-10 pain scale needs to go.) Notably, this idea of pain as a story was also true of bystanders, because the surgeons rated the pain they thought was inflicted in accordance with the Peak-End rule as well. This may even be the case for loved ones surrounding a patient, whose secondhand suffering is affected by the arc of the pain-story experienced by their loved one.

Of course, there are complications with this idea, such the issue of chronic pain. This kind of persisting pain doesn't have an arc that resolves into an end. How can this disrupt the patient not only in their physical symptoms but in living with a concept of a pain that will go on without an end in sight? Pain covers a broad spectrum of experiences, but regardless, the idea of narrative and how it affects the experience of pain is important.

Gawande's insight connects to Marshall Duke's research about the family lines of survivors of the Holocaust. Knowing the story not only of your past but the history of your family, both the successes and failures, makes for more psychologically strong individuals. People need to experience their lives as stories, complete with the highs and lows; it actually makes them healthier and more mentally strong. Narrative is *healthy*.

I connected these findings about the Peak-End rule and the research Marshall Duke has engaged in the 2014 book, *The Body Keeps the Score*, by Dutch psychiatrist Bessel van der Kolk [21]. This text explores how traumatic events and traumatic memories can rewire the body and brain. Van der Kolk explains how people with histories of trauma may recall the devastating experiences or times of life in fractured moments or images, but sometimes these experiences are

partly or mostly forgotten. They lack narratives. Whether a person gets stuck in a time period, as with flashbacks of wartime, or if the person is unable to recall a time period of trauma, the personal narrative has been disrupted, even fractured. The brain continues to search for safety and react to dangers that are no longer present [21]. Either a part of the story gets lost, or a person gets stuck in a time in their story that ought to be the past, but becomes a sort of persisting, unending present. What do we do with a broken narrative?

Part of the path toward healing is incorporating fractured images and experiences into the full story of the person, so that their reflective self can view their experiences as a story-unified whole. Van der Kolk's text isn't the first book to make such claims. A psychologist at UT Austin, James Pennebaker, conducted studies in the 1990s about journaling. His work has become important to our understanding about the healing power of the journaling process, when it is done in a manner of divulging feelings and molding the story of the self, rather than just dictating the facts of the events without emoting or being in touch with the information. One of Dr. Pennebaker's papers, "Writing about Emotional Experiences as a Therapeutic Process," finds that "people who benefitted from the writing began with poorly organized descriptions and progressed to coherent stories by the last day of writing" [22]. Even if one begins without seeing trauma as a story, the process of finding the story becomes a root of healing, and repair of the experience of one's life as a story.

The importance of narrative cannot be overestimated: whether it involves medical procedures, trauma, or how our bloodline situates us in the world and in human history, *we need to know our story, pains and pleasures, our deepest experiences, successes and failures, joys and traumas alike.* Where exactly does metaphor come into play here, though?

Metaphor could play a significant role in the creation of narratives. In Thibodeau's and Boroditsky's reasoning study, metaphor created a sort of a narrative through which the idea of "crime" is understood. It generates an overlying structure. How do people talk about their whole lives and how some particular event affected them in an emotional way? Almost always, people find themselves in analogical and metaphorical language.

If we think about how emotions are expressed, metaphor blooms all over the concept of narrative. Metaphors may represent how stories are told with their linguistic and nonlinguistic symbols, and how themes are threaded and communicated. We need only look at the work of Michael Lucker and the success of movies in the entertainment industry to know that seeing lives as stories is something intuitive and appealing to humankind. Creating meaningful narratives isn't just something needed in fictional worlds, or in entertainment, but in a person's understanding of their very self. Notably, finding and expressing metaphors doesn't even have to be in words. Metaphors can even help us to identify whole ways of thinking or ways of seeing one's story, and finding what kinds of metaphors to turn away from, and what kinds to turn towards.

Metaphor, sometimes, is all we have to name the nameless. To begin the trek from the opacity of pain and suffering and lack of story, into the weaving of those first frayed strands. This could be the next step in reclaiming our narratives, through the verbal and nonverbal ways we speak to others, and speak to ourselves.

SUMMARY AND CONCLUSION

The findings of the present study have been presented, first, by defining what analogy and metaphor are, as overlapping Venn Diagrams of meaning. Analogies must have 1:1

mappings of relational structure, similarities that must resolve. The similarities used in a metaphor can and may resolve, but some metaphors don't have this structure. Both analogies and metaphors can draw upon surface or relational similarities, but the more meaningful (and also more difficult to articulate) similarities are about relations, not surface properties. Metaphors about relations appear in all kinds of areas of study, and they are used both in concepts themselves and in the process of teaching/learning new information.

I have also discussed my work's relation to the existing literature. There is other work about conceptual metaphor and the development of human cognition around similarity and analogy. There is also research about how metaphors and the ideas and valences they introduce can affect our reasoning. But until now, there has been no study of educators at R1 universities asking them how they think they use metaphors as researchers and educators, who most needs metaphor, whether they can explain something from their fields without using metaphor, what are the best and the worst things that metaphors can do, and whether metaphors have to be in words. Although there is some work on how metaphor is used in fields such as science [9], no one has tried to compare various disciplines, and various sorts of educators within each discipline, to find the trends and the differences in metaphor use. My study investigates not just the concepts, but the applications of metaphors. I have engaged in research not just about one field, but several wide-ranging fields, and both the research and the teaching within these fields, to find where all of the elements of metaphors are connected or disconnected from each other.

This study has found that metaphor can be used to connect new ideas as a way of expressing creativity, to hypothesize and consider imaginary futures, to allow us to communicate more efficiently, to create worthwhile objects of thought, and to build nonverbal metaphorical themes into movies and into our very lives. However, metaphor is a tool which should be

handled with care and wisdom, because horrible outcomes can also result from metaphor. These include confusion, an incorrect or incomplete comprehension of an idea, misdirection of one's reasoning, or perpetuation of oppression through the continuation of harmful, prejudiced narrative-building about certain populations.

People use metaphor everywhere: in unnoticed dead metaphors, in the terminology of all disciplines, in explaining ideas in writing or in class, and even in ways of thinking as human minds notice similarities that must be thinkable before they are speakable.

Not all the participants agreed on all matters, of course, and many brought unique ideas and examples to the table. Many also brought new questions that have yet to be investigated, but that are worth considering and looking into. Of course, this population was limited in that it was largely professors and lecturers from one university, and instructors who probably already believed metaphor was important, for they were willing to give generously of their time to talk about it. This is unlikely to be a representative sample of the entire population of lecturers and professors, which validates instead of invalidates my findings. If professors who are conscious of metaphor are telling me about their peers who aren't aware of metaphor, or who aren't leveraging it as a teaching tool; if there are professors who think that they don't need to discuss metaphor and the ways it affects their teaching, learning and reasoning; then there is a lot of knowledge-spreading and knowledge-building left to do, both for those educators and for me as the investigating scientist.

As for the questions I most immediately plan to pursue, I hope that I will not only go onward to uncover alleged uses of metaphor and viewpoints on metaphor, but to empirically investigate how metaphor works in ethical concerns, such as in medical settings. I plan to investigate how metaphor can play a role in ethics and in narrative, especially in how it can

scaffold an individual's healing process as they rebuild the fractured parts of their life story so that they, too, can bury their figurines and put them to rest.

APPENDIX: INTERVIEWEE PORTRAITS

Instead of speaking for these wonderful professors and lecturers, I thought I'd let them tell you about themselves. In some cases, I have shortened their summaries for succinctness.

Daniel Bosch: At Emory I'm a lecturer in English, and I have a five-course load [to teach]. There is no research expected of a lecturer at Emory so I am not required to do it to maintain my job. I do write essays, poems, stories, when time permits. I can say that since my primary goal in life is to understand poems, and literature, and to try to be a maker of poems and literature, that's what I aspire to. I am very much trying to give [my students] a practitioner's side of it. I'm coming from is a practitioner's side, and I feel that is a lot of the added value that I have as opposed to others here, working in the academy.

Marshall Duke: I'm trained as a clinical psychologist… I teach psychotherapy …I'm a clinical supervisor as well, trying to train the upcoming psychotherapists. Over the years I've taught psychology of fiction, psychology of creativity, psychology of film, psychology of art, history of psychology, graduate courses in psychotherapy, graduate courses in psychological assessment…the most recent thing is probably the work on narratives, family narratives, knowledge of family stories and resilience, or the ability to bounce back from adversity in life. And Professor Fivush and I did research on that for about 12 years following up after 9/11, looking at how children and families responded to what happened…We found out that the more you know about your family history, the stronger you typically are psychologically.

Arri Eisen: I'm a professor of pedagogy in the Biology Department [at Emory]. I started teaching here in 1990 about 30 years ago. I was initially hired to teach an honors biochemistry class because I got a PhD in biochemistry. I got really fascinated with teaching and decided I wanted to spend my career doing that. One thing I learned early on was that, to really teach science well, it's important to engage really the rest of the disciplines. Especially disciplines that look at what we believe and why because science has had such a massive impact on that… I've done everything from working with molecules and understanding genes to studying how people

learn to putting those things together. Our latest project is with the Tibetan monks and nuns, which is another project that brings together all of these different things I was talking about.

Rosemarie Garland-Thomson: I'm an English professor and have been here at Emory teaching feminist theory, American literature, and critical disability studies since 2002. I have worked for the last 20 years in this capacity, but also doing field-building and knowledge-building work in the relatively new interdisciplinary area of what we now call critical disabilities studies. I've been more recently working in the area of bioethics, which is an applied field. I have been able to take the work I've been doing in the humanities-based investigation and enterprise of what I'm calling critical disability theory and studies, and thinking about how that might work in biomedical ethics, and biomedical decision making.

Dedre Gentner: [My research] is mainly about analogy and similarity… I think of metaphor as analogy, but different in certain ways. Often, it is just a form of analogy, and then there are other kinds of metaphor that aren't. This isn't all that my research is about, it's also about language acquisition, language influences on cognition, and the interaction between language acquisition and use, and the buildup of relational knowledge…. [in graduate school] I worked with Dave Rumelhart. My interest was in verb meaning, and verbs as I now think of them are basically little institutionalized analogies, it's the same relational pattern, and you just use it across different sentences.

Sid Horton: I'm a psycholinguist. I study the cognitive processes that underlie high level issues in language production and comprehension. So, a lot of my work focuses on topics related to pragmatics, [because] I'm interested in how language is used by people, in contexts, to achieve particular goals with particular audiences…I'm interested in how people engage in perspective taking. I also do work in figurative language; I do work in metaphor of course. I work in narrative comprehension; I'm interested in how people understand spoken and written language. The standard classes I teach every year are I teach a large class in cognitive psychology… I teach research methods for undergraduates… I also co-teach a graduate seminar every three years or so with a colleague of mine on experimental pragmatics.

Gillian Hue: My research now is no longer in the bench sciences, I do neuro-ethics research. I look at the scholarship of teaching and learning… but in the past I worked with rats and mice, and I was looking at sleep and movement disorders, as well as dopamine and the spinal cord,

which is basic neuroscience research. At Emory I teach the NBB 401 [course], which is our senior seminar writing course... I co-teach the non-majors' neuroscience course, which is a very different population of students. I teach in the Emory Tibetan Science Initiative…In a past life I taught at Georgia Gwinnett College, and I was hired into their psychology department or program, and so I taught the biological psychology courses. I taught the more neuro-ish courses, as well as research design, and intro to statistics courses for the behavioral sciences.

Andy Kazama: I teach my intro Psych 110 class…I teach a research methods course, a neurobiology of PTSD [Post Traumatic Stress Disorder] course, and now a freshman seminar which is the science of study. The type of research that I do is working with nonhuman primates looking at emotion regulation primarily, but also things like decision making and taking a developmental perspective on a lot of these things. The PTSD course is super relevant to my actual research because I do this basic research on emotion regulation, and we do this collaboration with people who work with rodent models of PTSD and human models of PTSD. And then the monkey model is in between, we're not giving monkeys PTSD, we're looking at these more translational, emotion regulation principals…. What I love about neuroscience, it's this beautiful combination that's the ultimate liberal art. It's this combination of biology, chemistry, physics, psychology, philosophy.

Joe Le Doux: I've been here [at the Georgia Institute for Technology] for 20 years, and I teach biomedical engineering classes, mainly to undergraduates. And I'm also the associate chair for the undergraduate learning and experience, so I'm sort of responsible for the undergraduate program. I used to do gene therapy work way back in the day but I got way more interested in this. For teaching, a lot of times I teach this course called conservation… back in the day when I first started here, I tried to do it through lecture pretty much, and it wasn't working very well, so I was very unsatisfied with it. And at the same time, we were trying out this new way of doing things called "problem based learning"… I ended up developing something called "the problem solving studio" to teach this class. And so rather than lecture, we give them problems, and it's structured so that they always work with somebody else, and you get feedback from nearby teams and the professor... And that got me interested in education research.

Michael Lucker: I'm a Professor of film and media at UNG, University of North Georgia; also I'm adjunct here at Emory university and adjunct at Reinhardt university… My specialty is based

on my experience writing… for film, writing for television, writing for commercials. I worked for years in Los Angeles, in the studios and DreamWorks, Disney, Paramount, Fox and Universal. Then I came back to the South… I started directing and producing here and have had some success with a variety of networks, like HGTV, cartoon network, MSNBC, Discovery… but I started teaching, and I found that that was a great deal of fun and incredibly rewarding, and people thought I was good at it…So I leaned into that and this whole second chapter of my career. I also do my own screenwriting workshops for civilians that are not college students, and it's called Screenwriter School, and I teach four of those per year … And then in addition to that I am still writing, I just got hired to write a movie last week. I was hired by the Georgia Film academy last year to develop a curriculum for teaching screenwriting in high schools across the state of Georgia.

Catherine Nickerson: My research is in crime fiction, both American and British… I teach a variety of courses, very few of my courses are actually in crime fiction, more are in women's writing. And I teach a course on haunted houses in women's fiction, I teach courses in the history of childhood, I used to teach a course in Harry Potter. American lit broadly 19th and 20th century… Crime fiction has a reputation of being overly simple, being beach books, of being fluff, when it's actually doing some very serious work in social criticism. When you talk about crime fiction you are talking about power in society. Who are the villains, who are the good guys, who is going to be a victim, who is going to rescue them, and so those questions are really interesting to me as a lens for looking at a culture. I'm definitely a person who thinks a lot about how literature is a reflection and sometimes a commentary on the culture from which it emerges**.**

Acknowledgments

To my interviewees and advisor: my *deepest* (that's a metaphor) gratitude!

Not a word of this thesis could have been written if it weren't for the educators who lent me their precious time, their precious thoughts, and their unique perspectives and opinions. I am so thankful to each one of my interviewees.

Dr. Gentner and Dr. Horton, thank you for clearing up your time to speak to a non-Northwestern student who wished to fly in and pick your brains. I will forever cherish my first independent research related trip and how our conversations kept me rapt.

Dr. Eisen and Dr. Hue, your insights about bioethics and your work in the Emory Tibet Project brought to light so much that I didn't know I was looking for. Thank you for being willing to speak with a student unfamiliar with your work in Biology/Neuroscience and ethics.

Dr. Le Doux, thank you for being my Georgia-Tech interviewee; incorporating the area of engineering into my biology category was a dream for me. Your insight and kindness made me so grateful that I could make the trek to your campus.

Dr. Nickerson, I will still always wish I had gotten to take your Emily Dickinson course. Your candid responses about the best and worst of metaphor gave so much to me. Dr. Garland-Thomson, thank you for the important work you do in disabilities studies, and I hope that we built a world of metaphors that do better work in the world.

Dr. Kazama, thank you for teaching this graduate-student-to-be her first college level psychology class, and for explaining to me so much about working with monkeys and the research you're doing to help with PTSD. Dr. Duke, your work on family narratives swept me away, and as any meaningful intellectual conversation does, you swept me away not only with your ideas but with the soul behind your work.

Daniel Bosch, thank you for all the ways you have shaped my ideas of poetry and what it means to be a poet. It has been honest and laborious work of the most fulfilling kind.

Michael Lucker, I still tell people that my screenwriting professor was a/the writer of *Spirit: Stallion of the Cimarron*! That movie put a song in my heart as a young child and it has had a hand in building my brain full of dreams.

More than anything, I want to thank my wonderful thesis advisor, Dr. Laura Otis. To be your student since my first semester as a freshman is perhaps the greatest blessing of my collegiate experience, and I hope to be an educator with your level of brilliance and kindness. Not only have you taught me about writing well and thinking more deeply, but you have taught me that a *good* mentor makes their student want to be more like them, but a *great* mentor makes their student want to be more like themselves, the self they didn't know they could be. Thank you for leading me into becoming more of myself as a thinker, a writer, and a human being.

WORKS CITED

[1] Thibodeau, Paul H., Boroditsky, Lera. *"Metaphors We Think With: The Role of Metaphor in Reasoning."PloS ONE,*vol. 6, no. 2, 2011, pp.,

[2] Lakoff, George, and Mark Johnson. *Metaphors We Live By*. University of Chicago Press, 1980.

[3] Bowdle, Brian F., and Dedre Gentner. "The Career of Metaphor." *Psychological Review*, vol. 112, no. 1, 2005, pp. 193–216., doi:10.1037/0033-295x.112.1.193.

[4] Hills, David. "Metaphor." *Stanford Encyclopedia of Philosophy,* Stanford University, 6 Sept. 2016, plato.stanford.edu/entries/metaphor/#:~:text=.

[5] Aristotle, et al. *Aristotle Poetics*. Brill, 2012.

[6] Lacey, Simon, et al. "Metaphorically Feeling: Comprehending Textural Metaphors Activates Somatosensory Cortex." *Brain & Language*, 2 Feb. 2012, doi:10.1016/j.bandl.2011.12.016.

[7] Nijs, Jo, et al. “Explaining Pain Following Cancer: a Practical Guide for Clinicians.” *Brazilian Journal of Physical Therapy*, Associação Brasileira De Pesquisa e Pós-Graduação Em Fisioterapia, 2019, www.ncbi.nlm.nih.gov/pmc/articles/PMC6823686/.

[8] Ha, Jennifer Fong, and Nancy Longnecker. “Doctor-Patient Communication: A Review.” *The Ochsner Journal*, U.S. National Library of Medicine, 2010, www.ncbi.nlm.nih.gov/pmc/articles/pmid/21603354/.

[9] Brown, Theodore L. *Making Truth: Metaphor in Science*. University of Illinois Press, 2008.

[10] Christie, Stella, and Dedre Gentner. “Where Hypotheses Come From: Learning New Relations by Structural Alignment,’ .” *Journal of Cognition and Development*, vol. 11, no. 3, 16 Aug. 2010, pp. 356–373., doi:10.1080/15248371003700015.

[11] Gentner, Dedre, and Julie Colhoun. “Analogical Processes in Human Thinking and Learning.” *SpringerLink*, Springer, Berlin, Heidelberg, 1 Jan. 1970, link.springer.com/chapter/10.1007%2F978-3-642-03129-8_3.

[12] Cummings, E.E. “E.E. Cummings: Complete Poems 1904-1962 by E.E. Cummings.” *Goodreads*, Goodreads, 17 Apr. 1994, www.goodreads.com/book/show/26596.E_E_Cummings.

[13] Shakespeare, William, and David Garrick. *Romeo and Juliet*. Cornmarket Press, 1969.

[14] Carey, Susan. *The Origin of Concepts*. Oxford Univ. Press, 2011.

[15] Gentner, Dedre. “Some Interesting Differences between Nouns and Verbs.” *Northwestern Scholars*, 1 Jan. 1981, www.scholars.northwestern.edu/en/publications/some-interesting-differences-between-nouns-and-verbs.

[16] Gawande, Atul. *Being Mortal*. Anchor Canada, 2017.

[17] Garland-Thomson, Rosemarie. *Extraordinary Bodies: Figuring Physical Disability in American Culture and Literature*. Columbia University Press, 2017.

[18] Delbaere, Marjorie. “Metaphors and Myths in Pharmaceutical Advertising, Social Science & Medicine.” *DeepDyve*, Elsevier, 1 Apr. 2013, www.deepdyve.com/lp/elsevier/metaphors-and-myths-in-pharmaceutical-advertising-tgkLwomnep.

[19] Hudak, Pamela L, et al. “The Metaphor of Patients as Customers: Implications for Measuring Satisfaction.” *Journal of Clinical Epidemiology*, U.S. National Library of Medicine, Feb. 2003, www.ncbi.nlm.nih.gov/pubmed/12654403.

[20] Skelton, John R, et al. “A Concordance-Based Study of Metaphoric Expressions Used by General Practitioners and Patients in Consultation.” *The British Journal of General Practice : the Journal of the Royal College of General Practitioners*, U.S. National Library of Medicine, Feb. 2002, www.ncbi.nlm.nih.gov/pmc/articles/PMC1314231/.

[21] A., Van der Kolk Bessel. *The Body Keeps the Score: Brain, Mind, and Body in the Healing of Trauma*. Penguin Books, 2015.

[22] Pennebaker, James W. “Writing About Emotional Experiences as a Therapeutic Process - James W. Pennebaker, 1997.” *SAGE Journals*, journals.sagepub.com/doi/abs/10.1111/j.1467-9280.1997.tb00403.x.

[23] Eisen, Arri, et al. *The Enlightened Gene: Biology, Buddhism, and the Convergence That Explains the World*. ForeEdge, 2018.

[24] rachellikesranch_2016. “'Spins My Clothes in a Wet Metal Tube Then Bakes Them in a Different Metal Tube to Undo the Wetness' Gfriska-Freak in Literature This Is Called Defamiliarization so Congrats This Post Is Officially a Literary Masterpiece ~S.Ehungwy In My House Its Called Laundry! Thank You! - IFunny :).” *IFunny*, ifunny.co/picture/spins-my-clothes-in-a-wet-metal-tube-then-bakes-7Jq9VYQA5.

[25] Sontag, Susan. *Illness as Metaphor*. Penguin Books, 2002.

[26] Tabor, Roger K. *Roger Tabor's Cat Behavior: a Complete Guide to Understanding How Your Cat Works*. Reader's Digest, 1998.

[27] “Why We're So Smart.” *Language in Mind: Advances in the Study of Language and Thought*, by Dedre Gentner and Susan Goldin-Meadow, MIT Press, 2003.

[28] Tolstoy, Leo, and Aylmer Maude. *Strider - the Story of a Horse*. Borderland Books, 2015.

[29] Garland-Thomson, Rosemarie. “How We Got to CRISPR: The Dilemma of Being Human.” *Perspectives in Biology and Medicine*, vol. 63, no. 1, 2020, pp. 28–43., doi:10.1353/pbm.2020.0002.