**UNIVERSIDADE ESTADUAL DE CAMPINAS**

**INSTITUTO DE ESTUDOS DA LINGUAGEM**

**JOSIE HELEN SIMAN**

# METAPHOR PEACE: A COMPLEX SYSTEMS APPROACH TO METAPHORS AND COGNITION

# A PAZ DAS METÁFORAS: UMA ABORDAGEM BASEADA EM SISTEMAS COMPLEXOS PARA METÁFORAS E COGNIÇÃO

**CAMPINAS**
**2022**

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**Thesis presented to the Institute of Language Studies of the University of Campinas in partial fulfillment of the requirements for the degree of Doctor, in the area of Linguistics.**

**Tese de doutorado apresentada ao Instituto de Estudos da Linguagem da Universidade Estadual de Campinas para obtenção do título de Doutora em Linguística.**

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Este arquivo digital corresponde à versão final da tese de doutorado defendida pela aluna Josie Helen Siman e orientada pelo Prof. PhD. Thiago Oliveira da Motta Sampaio.

**CAMPINAS**
**2022**

Ficha catalográfica
Universidade Estadual de Campinas
Biblioteca do Instituto de Estudos da Linguagem
Tiago Pereira Nocera - CRB 8/10468

Si42m

Siman, Josie Helen, 1986-
Metaphor peace : a complex systems approach to metaphors and cognition / Josie Helen Siman. – Campinas, SP : [s.n.], 2022.

Orientadores: Thiago Oliveira da Motta Sampaio e Gerard Steen.
Tese (doutorado) – Universidade Estadual de Campinas, Instituto de Estudos da Linguagem.
Em regime interinstitucional com: University of Amsterdam.

1. Metáfora. 2. Cognição. 3. Sistemas complexos. I. Sampaio, Thiago Oliveira da Motta, 1984-. II. Steen, Gerard. III. Universidade Estadual de Campinas. Instituto de Estudos da Linguagem. V. Título.

Informações para Biblioteca Digital

**Título em outro idioma:** A paz das metáforas : uma abordagem baseada em sistemas complexos para metáforas e cognição
**Palavras-chave em inglês:**
Metaphor
Cognition
Complex systems
**Área de concentração:** Linguística
**Titulação:** Doutora em Linguística
**Banca examinadora:**
Thiago Oliveira da Motta Sampaio [Orientador]
Eleonora Albano
Hamad Al-Azary
Michael Spivey
Matthew McGlone
**Data de defesa:** 13-04-2022
**Programa de Pós-Graduação:** Linguística

**Identificação e informações acadêmicas do(a) aluno(a)**
- ORCID do autor: https://orcid.org/0000-0002-8868-194
- Currículo Lattes do autor: http://lattes.cnpq.br/1860123700075602

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**IEL/UNICAMP**
**2022**

**Ata da defesa, assinada pelos membros da Comissão Examinadora, consta no SIGA/Sistema de Fluxo de Dissertação/Tese e na Secretaria de Pós Graduação do IEL.**

The universe is composed of “order” and “chaos”—at least from the metaphorical perspective. Oddly enough, however, it is to this “metaphorical” universe that our nervous system appears to have adapted. - Peterson, 1999.

Poised midway between the unvisualizable cosmic vastness of curved spacetime and the dubious, shadowy flickerings of charged quanta, we human beings, more like rainbows and mirages than like raindrops or boulders, are unpredictable self-writing poems—vague, metaphorical, ambiguous, and sometimes exceedingly beautiful. - Hofstadter, 2007

This thesis is dedicated to Raymond W. Gibbs Jr.,
author of Metaphor Wars (2017). Many issues addressed in this
thesis came up in our fruitful conversations about metaphors.

**Acknowledgements**

I would like to thank my advisor Thiago Sampaio for embarking on this journey with me and helping me out in all the many crossroads that I have encountered. Thiago has always encouraged me to study what I like, regardless of his own interests. That is something very rare in academia - this makes him a special person and a great advisor. Our passion for cognitive science made discussions and pursuit of knowledge very exciting. And we have an incredible group of students in his Lab - LAPROS - who I also would like to thank for sharing great moments of discussions and work together: Giovanna Rizzo, Thuany Teixeira, Fernando Sabatini, and everyone else.

This work would not be possible without the support of an entire community in my University - from great employees (special thanks to Claudio Platero) to great professors (special thanks to Isabella Tardin). And thanks to the founding agency CNPq – Conselho Nacional de Desenvolvimento Científico e Tecnológico (140359/2018-4) for supporting my research. I would like to thank the Department of Linguistics and Santa Fe Institute for supporting me in taking the course "Complexity Interactive" in 2021.

I would like to thank my beloved friends Letícia Kolberg and Nara Figueiredo, and my inspiring family members, Hélio Pedrini and Luiz Celso Gomes Júnior, for being so kind, understanding, and helpful.

I was lucky enough to have great conversations with many generous scholars along the way. Thank you, professors Marco Ruffino, Monica Gonzalez-Marquez, Hamad Al-Azary, Kristen Elmore, Gerard Steen, Mark Turner, Miguel Fuentes, Rogério Severo, Giovanni Rolla, Matthew McGlone, Eleonora Albano, Suelen Martins, Pablo Faria, and Michel Spivey.

This thesis is dedicated to Ray Gibbs, with whom I had amazing conversations about metaphors, cognition, science, and complex systems. These are very hard and thorny subjects, and most scholars shy away from having any deep discussion about different theories and issues in our field. Gibbs was very generous with his time in discussing these issues with me. He has changed the way I look at metaphors and my work. Meeting him and collaborating with him - even if briefly - was very important to me as a scholar.

**Abstract:**

Theories about metaphors make categorical claims, considering that all metaphors in all contexts are processed the same way. There are also some pluralistic approaches that try to divide metaphors into some binary categories and claim that the first type is processed one way, and the second type is processed another way (e.g., conventional vs. novel; deliberate vs. non-deliberate). These divisions can be of limited utility, but metaphors are a much-multifaceted phenomenon. The first problem with creating generalizations about metaphors is that metaphors are different among themselves in several dimensions. Moreover, metaphor processing is contextual. By context we mean the dynamic interactions between multiple factors, such as: previous information in the text, characteristics of the individual (age, sex, ideology, level of education, etc.), specific characteristics of metaphors (aptitude, familiarity, syntax, semantic density), etc.

Through a set of experiments in which we asked participants to paraphrase conceptual metaphors, we noticed how different metaphors have different profiles. Metaphors like "a theory is a building" and "life is a journey" have almost 100% of paraphrases consistent with the predictions of Conceptual Metaphor Theory, whereas a metaphor like "my relationship is a roller coaster ride" has almost none. But that does not mean that these metaphors need always be paraphrased like this since different types of contexts can change behavior. We also found that males tend to use fewer conceptual metaphors in their paraphrases and some novel metaphors that are derivative of conventional conceptual metaphors lead to an increase in conceptual metaphors in paraphrases.

We believe it is about time we stop using experiments to declare support or rejection of a theory and start to use them to understand what effects different contexts have on the behavior studied (e.g., metaphor processing, paraphrasing). It matters little what Lakoff has proposed conceptual metaphors are, but what we can collectively say they are, based on experimental evidence and other studies. Then what are conceptual metaphors? For Lakoff, they are a system of cross-domain mappings that are used automatically every time we encounter a metaphor. In this thesis, conceptual metaphors are (i) semantic associations of different kinds that connect metaphors; (ii) a probabilistic (rather than deterministic) constraint in meaning; (iii) cross-domain mappings established by use, not by principles. Since these mappings are established by use, they can be of multiple kinds (rather than what linguists stipulate), some conventional

metaphors may make use of them whereas others may not, and metaphors can be processed by cross-domain mappings in some contexts but not others.

Cognition is self-organized without a central command by interacting factors that exist in different timescales, from what you are seeing now, heard a week ago, all the way up to developmental and evolutionary history. Each act of metaphor processing, interpretation, or paraphrasing is unique. It is time we get over the excess generalizations that classic science has proposed and acknowledge the context-sensitive world of complex systems.

**Resumo:**

As teorias sobre metáforas fazem afirmações categóricas, considerando que todas as metáforas em todos os contextos são processadas da mesma maneira. Existem também algumas abordagens pluralistas que tentam dividir as metáforas em algumas categorias binárias e afirmam que o primeiro tipo é processado de uma maneira, e o segundo tipo processado de outra maneira (por exemplo, convencional vs nova; deliberada vs não deliberada). Essas divisões podem ser de utilidade limitada, mas as metáforas são um fenômeno muito multifacetado. O primeiro problema com a criação de generalizações sobre metáforas é que as metáforas são diferentes entre si em várias dimensões. Além disso, o processamento de metáforas é contextual. Por contexto entendemos as interações dinâmicas entre múltiplos fatores, tais como: informações prévias no texto, características do indivíduo (idade, sexo, ideologia, nível de educação, etc.), características específicas das metáforas (aptidão, familiaridade, sintaxe, densidade semântica), etc.

Por meio de um conjunto de experimentos em que pedimos aos participantes que parafraseassem metáforas conceituais, percebemos como diferentes metáforas têm perfis diferentes. Metáforas como “uma teoria é um edifício” e “a vida é uma jornada” têm quase 100% de paráfrases consistentes com as previsões da Teoria da Metáfora Conceitual, enquanto uma metáfora como “meu relacionamento é uma montanha-russa” não tem quase nenhuma. Mas isso não significa que essas metáforas precisam ser sempre parafraseadas assim, pois diferentes tipos de contextos podem mudar o comportamento. Também descobrimos que homens usam menos metáforas conceptuais em suas paráfrases, e que algumas metáforas novas que são derivadas de metáforas conceptuais levam a um aumento de metáforas conceptuais nas paráfrases.

Acreditamos que é hora de parar de usar experimentos para declarar apoio ou rejeição de uma teoria e começar a usá-los para entender quais efeitos diferentes contextos têm sobre o comportamento estudado (e.g., processamento de metáforas). Pouco importa o que Lakoff propôs que são metáforas conceituais, mas o que podemos coletivamente dizer que são, com base em evidências experimentais e outros estudos. Então, o que são metáforas conceituais? Para Lakoff, eles são um sistema de mapeamentos entre domínios que são usados automaticamente toda vez que encontramos uma metáfora. Nesta tese, metáforas conceituais são (i) associações semânticas de diferentes tipos que conectam metáforas; (ii) uma restrição probabilística (em vez de determinística) no significado; (iii) mapeamentos entre domínios

estabelecidos por uso, não por princípios. Como esses mapeamentos são estabelecidos pelo uso, eles podem ser de vários tipos (em vez do que os linguistas estipulam), algumas metáforas convencionais podem fazer uso deles, enquanto outras não, e as metáforas podem ser processadas por mapeamentos entre domínios em alguns contextos, mas não em outros.

A cognição é auto-organizada sem um comando central por fatores interativos que existem em diferentes escalas de tempo, desde o que você está vendo agora, ouviu há uma semana, até a história do desenvolvimento e da evolução. Cada ato de processamento de metáfora, interpretação ou paráfrase é único. É hora de superar as generalizações excessivas que a ciência clássica propôs e reconhecer o mundo sensível ao contexto dos sistemas complexos.

# Contents

> Discarding the unique characteristics that time and context impress on natural phenomena in favor of universal and eternal essences, therefore, had a [...] consequence: the very contingent details exhibited by the "many"—those idiosyncratic characteristics and vicissitudes that make each individual unlike any other—disappeared from ontology and epistemology as well. When time and context are banished, in other words, individuality is banished as well.
> Juarrero, 1999.

## 1. Introduction: a less generic approach to metaphors

Imagine the following situation:

You, politely: how is your fight against cancer?

Person: Are you saying that my body is a battlefield? Do mean I am a loser if I die from cancer?

You: No, I just meant how are things going in your life, are you treating the disease?

Person: I know very well what you mean by the metaphor you used!

Well, you have just been declared guilty of offending this person by Conceptual Metaphor Theory. This theory proposed fixed cross-domain mappings that should be automatically accessed every time you process a metaphor (LAKOFF, 2008). In this case (CANCER IS WAR), the body is mapped onto a battlefield, the patient is mapped onto a fighter, cancer is mapped onto an enemy, etc.

However, metaphor meaning is contextual, and this should have to go without saying. But here are some examples:

(1) Cancer begins with a single mistake within our bodies, so why would I want to think of my **body as an enemy** when, for the most part, it has served me well? I wasn't about to **go to war with myself** even when my body made a mistake.[1]

In the excerpt above, the body is the enemy, which contrasts with other uses of war metaphors in which cancer is the enemy and the body may be a battleground. In the excerpt below, many mapping possibilities are offered:

(2) Cancer, I soon learned, is my own cells going rogue. Suddenly all the combat language was confusing. **Am I the invading army or the battleground? Am I the soldier or a hostage the**

[1] Available at: https://www.rogelcancercenter.org/living-with-cancer/sharing-hope/war-metaphor-cancer-can-be-relieved-duty, accessed in Jan, 2022.

> **soldier's trying to liberate?** All of the above? If the chemotherapy and radiation and surgery and drugs don't work, and I die, will people be disappointed in me for not "fighting" hard enough? For me, cancer never felt like a war. Cancer wasn't something I "had," but a process my body was going through[2].

But why do cognitive linguists rarely (if ever) discuss metaphors' meaning as varied and contextual (at least sometimes independent from conceptual metaphors), even though proponents of other theories have said this before (GLUCKSBERG; MCGLONE, 1999)? The reasons are the following:

1 CMT wrongly assumed abstract concepts were poor in meaning, thus these concepts would get much of their meanings from metaphors. It is not possible to admit that metaphor meaning is varied and contextual when there is nothing in these abstract concepts beyond the metaphor.
2 The other meanings that metaphors can have do not fall in the scope of classic Cognitive Linguistics which is much more worried about schemas, frames, and domains. There is more to the mind than these constructs.
3 Classic cognitive linguists believe that science must generalize. Thus, theories are meant to be generic, to possibly contemplate most contexts. They are unaware of complex systems science, a science meant to tackle context-sensitive problems, like metaphor meaning.

Conceptual Metaphor Theory (LAKOFF; JOHNSON, 1980) is the most important metaphor theory for cognitive linguists – probably the only metaphor theory that most linguists will ever know. It is also one of the most popular metaphor theories for scholars from different fields – from anthropology to artificial intelligence. For more than forty years, psycholinguists have been fighting over the psychological plausibility of Conceptual Metaphor Theory (CMT), with mixed results from experiments (HOLYOAK; STAMENKOVIĆ, 2018). This is called the metaphor wars (GIBBS, 2017).

For many psychologists, CMT is more like a fun hypothesis that someday might bear fruits than a plausible theory (KATZ; AL-AZARY, 2017) and many illogical arguments have been pointed out in theory (MCGLONE, 2007). But for linguists and scholars from many different fields, CMT is the guideline that motivated millions of papers, projects, and social interventions (GIBBS, 2017). Most scholars say they care about experiments' results, but they

[2] Available at: https://edition.cnn.com/2017/07/21/opinions/cancer-is-not-a-war-jardin-opinion/index.html, accessed in Jan, 2022.

only know those that support the theory, and nothing is ever said about those that fail to support it (except for GIBBS, 2011; 2017).

Could that be that the experiments that support CMT are explained merely by the semantic association of concepts? Or are the experiments that support CMT just a case of "deliberate metaphors" that contrast with most metaphors that we use daily (STEEN, 2017)? Or, maybe, the experiments that fail to support CMT were just done wrongly, they have selected the wrong metaphor as stimuli (THIBODEAU; DURGIN, 2008)? Or yet, maybe all the literature in psycholinguistics is just not meant to make sense since the methodologies are too diverse? Or as Turner (TURNER, 2014) says about experiments: "garbage in, garbage out"? In this thesis, we argue that experimental diverse results make perfect sense.

For this thesis, the relevant question is not whether conceptual metaphors are psychologically plausible or not, but WHAT are conceptual metaphors and WHEN are they accessed.

For Lakoff (1993, 2008), conceptual metaphors are systems of cross-domain mappings that are pre-established in semantic memory and that are automatically and unconsciously accessed when we process conceptual metaphors. For example, "my marriage is on the rocks", "this relationship is going nowhere", "we are spinning our wheels" should all be processed by a system of cross-domain mappings that include lovers mapped onto travelers, relationship mapped onto vehicle, difficulties mapped onto obstacles, etc.

There are two facets to this theory, one concerns the information in semantic memory; we are not using conventional metaphors for the first time every time we process it. The second is the discursive aspect of metaphor processing. The theory predicts that every metaphor, in different and variable discursive situations, would be processed in the exact same way. This cannot be true. To ameliorate this problem in the theory, Gibbs (2017, 2019) proposes conceptual metaphors are processed probabilistically, which allows for contextual variations in how much the mappings are accessed (but we don't know if the author concedes that metaphors may be processed by information other than conceptual metaphors). At least, for this theory metaphors are not processed by a bloc of fixed mappings. Kövecses (2017, 2019) proposes that there are levels of metaphor processing, which can vary between contexts and go from less granulated schemas to full-blown domains of knowledge. But then, again little do we hear about other aspects of metaphors that do not fall within the scope of classic cognitive linguistics. For example, would this theory allow that a metaphor like "life is a journey", in some contexts, can mean "fun", or "full of attractions"?

Steen (2008; 2017) divides the multiple contexts into two, deliberate and non-deliberate, and conceptual metaphors should only be processed by cross-domain mappings in deliberate conditions, which are rare (we discuss this proposal in this thesis). In brief, the main problem with Gibbs' and Kövecses approaches – as far as we can say - is that they don't capture what happens with conceptual metaphors (e.g., "our relationship is a rollercoaster ride"), when they are not processed by conceptual metaphors (e.g., "full of ups and downs", "exciting", etc.). The main problem in Steen's approach is that metaphors – as far as we can say - can be processed by cross-domain mappings unconsciously, or in non-deliberate conditions (e.g., THIBODEAU; BORODITSKY, 2011; THIBODEAU; DURGIN, 2008). Other than that, all theories capture important facets of metaphors – there are just too many generalizations.

In this thesis, we propose an approach to metaphors based on complex systems. This is very much consistent with Gibbs' (2013, 2019) approach to metaphors, although we assume the author would not agree with everything we say here. This approach is built from different theories and values the relative contribution that all of them have (e.g., GIORA, 2008; BOWDLE; GENTNER, 2005; and so many others), as the following chapters will show (especially chapter 4).

In this thesis, we assume that the problem of "what are conceptual metaphors" in the semantic memory is a matter of embodied and linguistic uses. This is much less organized than CMT would want, and much more varied since people's individual experiences all affect what mappings and what other information (apart from mappings) are part of our memory. Thus, sometimes our memories can be somewhat similar to what Lakoff (1993), Köveces (2017), or even Grady (1994) proposes, but there is certainly much more information and individual-dependent differences. It is pointless to try to create a generic account of what metaphors look like in the mind (unless one wants to use this kind of theory to investigate novel phenomena). Moreover, what metaphors look like in the context of processing them greatly varies since metaphors are the outcome of the interactions between numerous factors, which include:

(i) conceptual: from previous experiences processing metaphors by cross-domain mappings.

(ii) individual: the experiences of each individual with the metaphors they have been more or less exposed to in a culture - people's minds are unique. This can be broken down into tendencies that can be found in different age groups, different sexes, different neurological make-ups, different personalities, different ideologies, etc.

(iii) linguistic: metaphor may appear in different grammatical forms, which can affect its meaning. Most notably, similes and metaphors can be processed differently (BOWDLE; GENTNER, 2005).

(iv) immediate information: this includes the interaction - or what a person knows about their interactant and what the interactant has recently said; priming effects, information that is available in the context and co-text, etc.

(v) metaphors' characteristics: familiarity, aptness, conventionality, semantic density, history of previous uses, etc.

(vi) time: onset of processing, or later stages of processing.

(vii) task: interpreting a poem, processing an uninteresting conversation, etc. See more in (Gibbs, 2013).

This thesis is called "metaphor peace" for a couple of reasons. One of them is a tribute to Ray Gibbs' "Metaphor Wars" (2017). The other reason is that this thesis puts together findings from different theoretical approaches that all contribute to our understanding of metaphors. Besides, we adopt a perspectivist approach to science, thus we are not claiming that all other approaches to metaphors are wrong and this one is right. In fact, all theories and approaches are limited and bound to become obsolete. Including this one. So, for now, let's make the most of complex systems science. We agree with Boeckx (BOECKX, 2014, p.163), who says: "Much like the emerging expanded synthesis in biology, linguistics will have to embrace pluralism, get rid of isolationist (i.e., modular, self-sufficient) tendencies, and revisit the works of old foes to treat them as friends."

Chapter two is about perspectivism. Generally, scholars who work with classic science are realists. They believe that there can be objective knowledge about the world and that they can access and study a reality that is independent of them. Perspectivists, on the other hand, believe that science is a human endeavor, biased by their specific cognition and their historicity. There is no God-eye point of view in science, there is only us. As amazing as science is, it is bound to change as our knowledge increases. Ideas that were once given up on may come back in other versions. Our knowledge is provisory and is as good as it allows us to develop, stay alive, and attenuate human suffering. In this chapter, we focus on our unsurmountable blindness to some information and its relative value/weight. We discuss how metaphors and narratives help us to condense information and develop ideas, but how they are but (biased) summaries of the complexity of the world. Understanding the wars over metaphors is also about understanding what we can know.

In chapter three, we give a brief overview of complex systems science and what it explains about cognition and metaphors. This chapter is meant to ease the reader who is a classic cognitive scientist into the exciting ideas and concepts from the field of complex systems science. We hope this chapter answers some of the initial doubts and skepticism readers have

about complex systems science. The reader will learn about some of the main concepts used in this field and how to apply them to metaphors. Moreover, the other chapters in this thesis will develop complex systems ideas in the pursuit of an integrative framework for metaphor processing.

In chapter four, we discuss the self-organization of metaphors. This chapter unites findings from different psycholinguistic theories into a complex systems perspective in which we emphasize that the mind self-organizes (i.e., organizes itself without a central command) in different contexts. Instead of the old computer metaphor of the mind, we use the metaphor of the mind as a high dimensional space or a landscape with attractors. The attractors are the tendencies that our minds have to self-organize in usual ways. That is, in processing the metaphor "My Ph.D. is a journey", one might find himself in a conceptual landscape being attracted by the meaning of "is long", or a schema like "has a beginning, middle, and end", or "is exciting", etc. Or yet, one can be in between all these meanings, never fully realizing any of them.

In chapter five, to make the case that the mind is continuous and fluid, instead of a computer with discrete symbols and states, we describe many ways in which we can see continuity in metaphoric phenomena. We explain the usual constructs of psycholinguistics that are continuous, that is, metaphor familiarity, conventionality, and aptness. Moreover, we discuss the continuity between metaphor/analogy and categorization, literal and metaphoric thinking, and other aspects of cognition. This is by no means all the continuous features of metaphors.

Chapter six is about the recent debates over Conceptual Metaphor Theory (CMT) and Deliberate Metaphor Theory (DMT). We propose that the way conceptual metaphors are processed depends on the context. And that deliberateness is not necessary or sufficient for a metaphor to be processed by cross-domain mappings/analogy. Instead, deliberateness might, in some contexts, increase the chance that metaphors are processed by analogy. Moreover, we propose that the difference between deliberate and non-deliberate metaphors should not be whether they are processed by cross-domain mappings or categorization. Instead, deliberate metaphors should be those whose processing deviates from conventional modes of processing in any way.

Chapter seven is less focused on metaphor processing and more focused on metaphor framing effect, which is the effect metaphors have in biasing our reasoning. We discuss non-linearities in these effects. That is, metaphors - which are themselves very different from one another - interact with different contextual variables. As a result, they may (i) do nothing; (ii)

bias thought; or (iii) have a reverse effect, in which participants resist the metaphor or have the opposite effect from what is expected.

From chapter eight on, we present our empirical work. In chapter 8, we present a qualitative analysis of how participants paraphrase metaphors and explain the analogy behind the metaphors. We noticed how different metaphors have different profiles, some of them are similar to CMT's predictions, and some are not. Moreover, we emphasize the richness of metaphors, contra the idea that abstract concepts are poor in content. In chapter 9, we noticed that males are less likely to use conceptual metaphors and that some novel metaphors lead to an increase in conceptual metaphor use in paraphrases.

The chapters on this thesis were written to be read independently, so there is some repetition of information in them. We hope this is not too much.

One of the central take-home messages from this thesis is that the results from metaphor experiments are not fixed and cannot arbitrate definitively between theories. Results fundamentally reflect the selection of metaphors curated for the experiments, the types of texts created to include those metaphors, and the tasks required from the participants.

> Pluralism is a way of mitigating the effects of having only partial knowledge—we cannot have *the* explanation, but we might develop the *best* explanation given the nature of the system of interest *and* our limited exploratory resources.
> Richards; Cilliers, 2001.

> Scientists are embedded in historically situated communities that offer and constrain possible interpretations of phenomena (Kuhn 1962/2012). Our appraisals of incoming observations of nature are necessarily made in the context of a web of belief, and in this holistic way our background beliefs and assumptions both allow us to make sense of events and accommodate them into our existing understanding of the world (Quine 1951).
> Mayer; Brancazio, 2021

## 2. From realism to perspectivism: science as a cognitive product

### 2.1 Introduction

For many years, scientists and philosophers have debated the nature of our scientific knowledge. Realists believe that there can be objective knowledge about an independent world. On the other hand, constructivists state that reality is socially constructed, which, for some, gives science an arbitrary status. When the pendulum of ideas swings both ways, there is always a middle ground. The third position is called (embodied) perspectivism, which is the idea that knowledge is emergent from the interaction between human cognition and the world.

If we look into the history of science, we learn a few things:

a- scientists can be completely wrong, despite consensus. For example, some of the best scientists have once thought that the cause of peptic ulcers was excess acidity. To challenge the consensus, a doctor decided to infect himself with bacteria, get ulcers, and successfully treat it with antibiotics (MILLER, 2013). This means that we don't always know when we are wrong – only time and research will show us that.

b- scientists can be affected by their cultures. For example, evolution was once believed to include progress from the least developed species to the more developed ones. Today we know that evolution does not make a species "more developed" than others, but more adapted to its own specific challenges. Our historic Victorian values regarding progress had affected how scientists conceived of nature. Another example is how technology affects the way we conceptualize the mind, by comparing it with a machine, a telephone, a computer, etc. Once again, we may not know our cultural limitations before we are able to surpass them.

c- scientists can be affected by human biology. For one thing, we are the only species that produce science, and we have a very specific makeup that is likely to affect how we experience and see the world. Mathematics was once thought to be a universal language, but many of its concepts seem to derive from human embodied experience (LAKOFF; NÚÑEZ, 2000).

Science is a human endeavor. It is meant to solve human problems and explain the world using categories that *humans* can understand. This is the paradox of science: we are not dealing with a reality that is independent of us, yet, what we produce cannot be reduced to mere stories, fantasies, delusions, or "language games". We make progress in ways that we can measure, save lives, fix things, and help people, even without having an objective understanding of reality. We create stories, but some stories are more apt than others – even if we don't always know what the aptest story is.

Singham (SINGHAM, 2020) proposes that scientific theories evolve in interaction with their local contingencies. Scientists are in search of what works best for the moment, regardless of what works best in the long run, says the author. For this reason, scientific theories follow a natural selection course, in which they are adapted to whatever current necessities and biases we have. Whatever comes out of science is not necessarily the holy grail of truth, but the result of our historic trajectory and the current challenges. In this sense, if we started science again from scratch we could have ended up with (more or less) different theories. Nevertheless, this is not meant to trivialize science's progress. Our empirical and naturalistic methods are still the best tool we have to develop knowledge that can help humanity in different ways.

In this paper, we develop the argument that science, as the product of the interactions between the world and our own human cognition, is like a story told from a perspective. It is like a story because the world is often too complex to be accounted for in theories and equations, thus we must select what goes in and what our narratives, equations, metaphors, and models. Equations, metaphors, and stories are all helpful tools in synthesizing the complexity of the studied phenomena.

In section 2, we present the philosophical position named "perspectivism", which proposes that there is no complete knowledge about the world – knowledge is partial and affected by our own points of view. We synthesize the world from a perspective, with the aid of narratives, equations, and metaphors. In section 3, we point out that, even though all sciences are a narrative, complex systems science explicitly acknowledges the importance of narratives to study complex, context-dependent, phenomena. In section 4, we discuss how metaphors are an important and partial tool to develop scientific ideas. In section 5, we discuss our blind spots – we don't see the world from every perspective at once, and we can be temporally and

permanently blind to some aspects of the world. In section 6, we discuss how diversity in science should be a way to compensate for our blind spots, but unfortunately, we are too biased to see the value in perspectives that are too different from our own. In section 7, we conclude by highlighting that science is perspectival, incomplete, and biased in different ways (i.e., there are different and incomplete approaches). The importance of understanding science incompleteness is that scientists should never fool themselves into thinking that their theory is the last word in a subject, and by acknowledging their limitations and biases, they can start to devise ways to overcome problems in science-making.

## 2.2 Embodied Perspectivism: how much can you trust what you see?

Perspectivism is an approach to science that lies in the middle ground between realism and anti-realism. It is predicated on the idea that there is no complete or universal perspective, or that there is no perspective from nowhere or from everywhere at once. "All perspectives are partial relative to their objects. Second, there is something real that each perspective is a perspective of" (GIERE, 1999, p.80). Embodied perspectivism is the idea that the perspectival constraints we have in science are further affected by our bodies and biology (not only culture, history, goals, etc.). For example, the types of colors humans can perceive is different from many other species. Colors are not something that is out there in the objects, nor are they something that is in our minds, but in the interaction between the two (GIERE, 2006). The same is valid for the constructs we have in science, they are emergent from an interaction between multiple factors, including biological, cultural, and historic ones.

As Danks (DANKS, 2019, p. 132) put it:

> Observations are not merely theory-laden but rather are theory- shaped or theory-distorted. Our understanding of human concepts implies that our scientific observations should be pulled toward the centroid of the relevant concepts; shaped by the functions for which we use those concepts; and potentially, even unknowingly, revised over time as the scientific concepts shift. More generally, the role of concepts that I have outlined in this section is significantly more active than one often finds in discussions of the theory-ladenness of observations. At the same time, I grant that everything I have written to this point is consistent with a philosophical account of theory-ladenness that is based on the fact that we humans perceive the world in ways that are distorted (depending on our concepts), and so scientific perception is distorted.

To state that science is an emergent product of cognition is a compromise between realism and anti-realism in the sense that we assume that there is a reality independent of us, but it is a reality that changes and evolves (i.e., it is dynamic) and our access to it is a product of the interactions between our cognitions and the world. In other words, our perception of reality is not fixed, but an action, and its product is emergent from the interaction between what

the object is and our goals, cognitive apparatus, knowledge, etc. We are always understanding something partial about reality, but we are also infusing it with our own cognition.

While for a realist to find correspondences with reality is enough, a perspectivist realist "(who takes the situated nature of our scientific knowledge at heart) would not consider 'correspondence with the world' enough", states Massimi (MASSIMI, 2017, p. 172). This is because there are no eternal truths since our knowledge is dependent on our historical times and our intellectual traditions.

More specifically, we consider that (i) our perception of reality is constrained by our human physiology (and changed by our technologies) - there is no God's eyes point of view. Moreover, our physiologies are different between individuals, which might confer us different embodied intuitions about the world - and science does benefit from our intuitions. This should partially explain not only different proclivities and insights but also why some of us may have difficulty understanding the value of other people's ideas in science. It is important to realize that these differences tend to be continuous, not a matter of all or nothing. Thus, they are generally not inaccessible to other humans. Besides (ii), our concepts (and goals, level of information, motivations, etc.) may be different enough to propel us in different ways. We are all affected by historicity, some of it may be discounted from our theories a posteriori, but we do not know if we can have atemporal theories, because we are always inserted in times.

One of the questions raised about perspectivism is whether it implies relativism. We believe not. First, we interact with reality, which means that we should not stray too far from each other's perspective, or that at least when we do, time and further research should bring us closer to each other's perspectives and apart again, provided novel interpretative frameworks are constantly being offered. In other words, we are not relativists because of the interactions with reality constraints ideas. Second, some theories and methodologies are attractors, they attract our perspectives closer to them. That is, even if we have unique perspectives, they are likely to be somewhat close to someone else's perspective. Thus, we may give up our own perspective on a few issues provided other proposals have enough overlap with our own (often we adopt someone else's perspective merely because we cannot study all subjects deeply enough to develop our own).

Being a part of a highly complex world, with more information than we can process as individuals, science is not the search for truth, but the search for the best fix for our problems. And, as we know, the best fix can change over time, either because we gained more knowledge or because the world has changed. Importantly, the best fix does not equate to a complete and

truthful knowledge of the world. We should add that, since we interact with the world in creating knowledge, scientific knowledge is not fully relativist and not fully objective.

## 2.3 Narratives for a complex world

All sciences are a narrative that is written from a perspective. That perspective is constrained by the object studied but is also the product of our physiologies, cultures, goals, and partial knowledge of the world. However, since classic science is generalist, it is taken by many to be objective (even though its change through time shows us that it is not). On the other hand, complex systems science takes explicit advantage of narratives to develop its analyses.

In studying complex systems, we are often dealing with systems that cannot be described in a page full of elegant equations (e.g., all biological systems). These are open systems that self-organize, which means that their final structure is not known from a blueprint: interactions with the environment further shape the system. Understanding these systems involve understanding the specific interactions created contextually between these systems' properties, background/historicity, and the environment.

There are two ways to understand these systems that unfold and develop in non-linear ways in time. One is to build computational models that cannot replicate the exact conditions of the real system but can show some plausible ways to account for its complexity. The other is to create narratives using complex systems science's explanatory models. None of these ways exempt us from conducting empirical research, but these approaches help us put findings into perspective. As Tranquillo (TRANQUILLO, 2019, p. 24) puts it:

> Adaptive and non-linear systems are in a constant state of becoming. They are often sensitive to onetime events that may forever change the trajectory of the system. How does one study events that will happen only once? A historical approach creates what are known as "just so" stories that attempt to retroactively connect together events. A story, however, is generally not repeatable and therefore not scientific. Complex systems theory does not entirely break with the scientific tradition but does attempt to uncover broad patterns within systems that lead to adaptation, sensitivity, and onetime events. As such it can sometimes provide insights into systems that are becoming or contextually dependent.

One of the ways we deal with complex problems as the origins of life, mind, and language is by supplementing empirical research not only with computational models but also with stories of how these entities might have evolved. With these stories we hope, of course, to explain the world and to have new insights that lead us to new discoveries. There are a lot of discussions that have been gaining ground in complex systems research.

Any behavior is a specific self-organized process. Thus, to account for behavior - as much as to account for the particular way that a snowflake has gained its current shape - we need to understand the plausible possible ways that the behavior would have turned out, then, try to reconstruct its current state by considering its particular trajectory (JUARRERO, 1999). It is important to have in mind that complex systems' behavior is not predictable or postdictable with absolute certainty (e.g., knowing someone is hardworking does not tell us what she will do next). Thus, our attempts to gain insight into the behavior - consistent with our perspectivist ontology - are interpreted (i.e., it is not a deduction). Because we cannot possibly account for all variables and all nonlinear interactions that might have affected the system, our readings are partial, and biased by our current knowledge.

Besides, it is important to acknowledge how some investigated phenomena are embedded in time and space and have historicity (e.g., cognition or quantum phenomena), just as much as the investigator of the phenomena is embedded in a context. This double historicity, as pointed out by Juarrero (1999), affects the pragmatics of explanation. It does not mean, as postmodernists would claim, that any interpretation is just as good as the other or that we are on relativistic grounds. Interpretation is constrained by its object, which makes some interpretations more plausible than others.

One might ask why to undertake such a partial endeavor that is to explain a complex system's unique trajectory. The reason is, as mentioned, to try to gain insight into an otherwise elusive phenomenon. Another reason is that our classic science is partial and biased as well. So instead of having only one biased narrative that comes from classic science, and that treats phenomena as generic - which allows for some probabilistic prediction, we can try to model a phenomenon more realistically. That is, we can acknowledge variables that we know affect the phenomenon and that would be dismissed in a classic generic approach to it. In short, the world (and science) makes more sense when we do not have to dismiss the multiple probabilistic factors that interact in real-time to produce complex behavior.

As an example, consider this excerpt from Juarrero (1999, p. 224):

> Explaining why the agent took this path rather than that after forming the prior intention will require reconstructing the agent's background, circumstances, particular frame of mind, and reasoning, whether self-conscious or not. Once the explainer establishes, for example, that Willy Sutton's contrast space spanned the alternatives "rob banks"—rather than, say, people, movie theaters, or supermarkets—it will be necessary to explain why banks were the proximate attractor: "because that's where the money is." Reconstructing the mental attractor that constrained Sutton's behavior requires accounting for the particular behavioral trajectory by situating it in its full historical, social, physical, and psychological context and showing how interaction with that context changed that particular alternative's prior probability.

Any behavior, from deciding to rob a bank to comprehending a metaphor in a text is the product of many interacting constraints that are specific to the agent's historicity, circumstances, goals, tasks, etc. While classic science helps us identify attractors that affect behavior, complex systems narratives help us put the probabilistic factors in an interpretative framework that can accommodate variation. Which is, possibly, a more plausible account of many phenomena we investigate.

## 2.4 We don't see something until we have the right metaphor for it

Science is a way to summarize the world via narratives, equations, and metaphors.

There is an interesting phenomenon experienced by students that, when learning about generative grammar, they start to parse language into syntax trees concomitantly with speech. Is that an indication that generative syntax is the correct approach to syntax? This would be tentative speculation if it were not for the fact that when we study complex systems, we start just as well to intuit attractor basins in our speech and behavior.

The metaphors and models we use in science help us develop our knowledge. They license what we look for and how we interpret the world, but they are not to be confused with reality. As Smaldino (SMALDINO, 2017) puts it, models are stupid simplifications, but we need them to develop science. And metaphors are knowingly partial representations of the world. As Lakoff and Johnson (LAKOFF; JOHNSON, 1980) famously noted, metaphors highlight some aspects of the world, at the expense of hiding others. That is why we tend to have multiple metaphors to characterize the same domain of experience. Love can be conceptualized as a journey (because it has obstacles), as war (because we fight each other), as a business (because we invest in it), as art (because we create beauty), as a game (because there can be winners and losers), etc. None of these metaphors is the "correct one", all of them are an emergent product of our interactions with the world, our presuppositions, goals, ideologies, and specific experiences. Why do scientists believe that metaphors used in science are any more correct than the multiple metaphors we have to describe different facets of love?

Metaphors play an important role in science in allowing us to see and investigate a phenomenon, but they also impose limitations on our progress. That is why progress may involve resistance to metaphors (GIBBS.; SIMAN, 2021). For example, behaviorists believed that the mind was a black box. In this conceptualization of the mind, we learn that we cannot

study what is “inside the mind”, only what is external to it: the behavior. This scientific perspective no doubt resulted in fruitful investigations that are still important (STADDON, 2021a, b). The metaphor of the mind as a computer was adopted in lieu of behaviorism (CHOMSKY, 1959), which has also resulted in our looking into different facets of language and cognition. As no metaphor is ever complete, today we have yet a new metaphor of the mind as a trajectory through a high-dimensional space (SPIVEY, 2007).

Tranquillo (TRANQUILLO, 2019, p.17) says that:

> A historian constructs a model when they tell a story that weaves together various facts. A politician debates another politician by arguing that they have a better model of how the world works and therefore know what to do to solve its problems. [...] Models are powerful for a variety of reasons. They generally strip away the messiness of the real world to bring into high definition a particular phenomenon. Irrelevant information and connections can be ignored.

No metaphor or model is likely to be complete, but instead of seeing all metaphors as revealing some incomplete facet of cognition, scientists engage in wars over the supposedly correct metaphor. Sometimes denying metaphors are metaphors (FODOR; MILLER; LANGENDOEN, 1980). The computer metaphor of the mind implies that the mind is like a computer in all relevant aspects (e.g., it processes inputs and produces outputs), whilst the differences are irrelevant (e.g., that the mind is organic whereas computers are not). The problem with metaphors and models in science is that, when they represent the current ceiling of our collective knowledge, it is hard to see what is next, and thus how our models and metaphors are inadequate. We do not see something until we have the right metaphor for it, and we do not see beyond the metaphor we have until we have more knowledge.

## 2.5 Blind spots and why we need diversity in science

Blind spots refer to what we don’t see in the world, this may be a temporary cognitive configuration that makes part of the world unavailable to us, like when we are concentrated on a task and miss out on what is irrelevant to the task. This may also be a deeper issue when our values strongly impede our understanding of the world in different ways. All the way down to how our physiologies make part of the world inaccessible.

Natural selection does not favor veridical perception of the world (i.e., we do not see objective reality). Computer simulations show that veridical perception is never more fit than nonveridical perceptions of equal complexity that are tuned to fitness (HOFFMAN; SINGH; PRAKASH, 2015). Because we do not see the world as is, we can miss out on information that is right in front of us.

In an experiment, Simons and Chabris (SIMONS; CHABRIS, 1999) asked participants to count how many times a team passes a ball around. While participants are focused on this task, a person dressed up as a gorilla walks into the middle of the action and thumps its chest. Participants not only do not see the gorilla but also believe that they would have seen the gorilla. This and many other experiments on selective attention show that what we see is dependent on what type of tasks we are engaged in.

A different type of experiment that shows our cognitive limitations is those that involve inhibitory effects. For example, one might think that upon encountering a metaphor, our minds run a search through all possible matches between two domains. However, much information is inhibited in our processing of metaphors. For example, when processing the metaphor "my lawyer is a shark", even though both lawyers and sharks can swim, this information is inhibited. The sense which is not inhibited refers to our usual interpretation that both are "vicious, predatorial, etc.". In this case, we only have access to what is culturally relevant. What we mean to point out here is that we can be temporarily blind to what is in front of us (as in the Gorilla experiment), and temporarily blind to our conceptual abilities (failing to notice similarities between domains).

When it comes to performing tasks, how we frame a question affects what or how much we can do. For example, in a test of creativity (GUILFORD, 1967), asking participants to "think of as many ideas as possible" or to "think of ideas that are creative", as compared with opaque goals, can affect participant's performance. Under the "think creatively" instruction, participants' responses are more homogeneous (FORTHMANN *et al.*, 2019). More generally, we would suggest that how scholars see a problem and their expectations of what types of answers are valid affect how much they can see in the world.

We are not aware of everything around us or of all possible ways to see the world at the same time. The way we see the world is affected by multiple variables. Education is one of them. Luria (LURIA, 1976) asked participants to state what some items have in common. Uneducated participants only reported situational similarities and refused to acknowledge abstract relations. Abstract relations were only acknowledged by educated participants. For example, participants were asked to group items for their similarities and exclude one item from the list. In the case of *hammer*, *wood*, *hatchet*, and *saw*, it was expected that by abstract thinking, they would exclude the wood and group all other items under the "tools" category. But participants insisted, even when confronted by the scholars who run the study, that all items must be together because we must cut wood with the other items. This is an example of

situational thinking. It is easier for educated people to transcend situational frames, but it is unknown how much more we can see provided we create more abstracted categories.

There is a lot we do not see in the world, which is tantamount to saying that there is much to discover. But it also means that in any given situation, we might be blind to problems and solutions, whereas other people may not. The fact that, as humans, we are similar in some aspects and different in others endows us with different sets of biases in how we interact with the world and affects what can emerge from the interactions. If we all have the same background, it is likely that we are going to be interested in the same problems and reach the same conclusions. One example of that is how the theory of natural selection was created by three scholars independently (MITCHELL, 2009). When people with the same background tackle the same problems, they are likely to reach the same conclusions. Darwin got fame because he had more evidence. Humans can solve the same problems in similar ways independently, which is seen in how we have created similar mythologies even across continents, and we all eat with our hands, even though this is not genetically coded.

Different sets of biases may also result in different interactions with the world, that is why we need diversity in science. We should not assume that we hold a privileged viewpoint of the world, at the same time that we must avoid the slippery perspective that everything holds the same status. There is obviously a difference between proposing to leave the room on the second floor by the window or by the door, as pointed out in a Tim Minchin's song. But sometimes, the best answer to a problem is not as clear as we would have. We must trust that others might see what we cannot see because we are biased by our own set of knowledge and goals. But this is not a naive trusting in the good of humankind because other people might be just as mistaken as we are. Science is faulty but is our best hope to see what evades our individual capacities.

## 2.6 The second gender, ethnicity, nationality, and more

Since different perspectives can make up for what we don't see in the world, it should be advantageous to science to have diversity in all of its forms and shapes. By diversity, we mean not only the need for people from different genders, ethnicity, and sexual orientation, but also from different backgrounds in general. The problem we have with dealing with different perspectives – and trusting that our own is limited – is that we are biased against the very perspectives that should be complementary to our own. If your values lead you to believe

analytical approaches to science are best, how would you trust and value holistic ones? They go against what you learned and treasure.

Holistic thinking is associated with women more than men, with people from East cultures more than West's, with complex systems science more than classic sciences. But classic science, West's culture, and men are the default in our practice. How can you look at what is different from you and learn to value what you are biased against? More than the distinction between holistic and analytic approaches, there is likely much more to different cognitions than we already know. But so far, we know that science is not a fair game for all.

Simone Beauvoir famously made the argument that society reflects the default gender: male. As the author says, the relation of the two sexes is not that of two electrical poles, for male is both positive and neutral. Women lag behind, constantly having to confront the male-influenced viewpoints that are set as, supposedly, common sense. Our cognitive model of science privileges white males, which are associated with the ideal of a genius. In an experiment, Elmore and Luna-Lucero (ELMORE; LUNA-LUCERO, 2017) tested participants' responses to the light bulb metaphor (which implies sudden insights) and the seed metaphor (which implies ideas that grow with time and effort) as applied to a male and a female scientist. The results show that when male scientists' inventions are described with a seed metaphor, participants rate the invention worse than when described as a lightbulb. The opposite pattern is found for women. What we would like to highlight here is that participants seem to be resistant to the idea that women can have the type of sudden insights that we associate with male geniuses like Einstein and Newton (GIBBS; SIMAN, 2021). Since the prototypical genius is a white man, we wonder what that says about our expectations regarding other ethnicities.

More generally, a further source of investigation is whether the more we look, sound, and write as white males from northern hemisphere scientists affects our chances in science. It is important to make clear what it means to state that science is biased toward white, male, northern hemisphere scientists because this concept is not shared by people in all fields. Anybody can have groundbreaking work in science and be successful, regardless of their gender, sexual orientation, and ethnicity (although not everybody is just as likely to). The problem is that most work in science is not like that. Thus, we are saying that, if we take all the work that falls in the middle of the bell curve, those that bear the cognitive marks of white males are going to be better evaluated than the others. This is, of course, an empirical question, not so far from what we already know. Experiments show that, given the exact same text with the sole alteration of who signs it, participants will rate the text higher if it is signed by a male than a female, or if it is signed by a professor than a student. It has also been shown that papers signed

by female authors are less likely to be judged as published material (KRAWCZYK; SMYK, 2016). We have blind peer review to guarantee that names and genders are not known as scholars evaluate each other's work, but we still do not know the effects of the possible cognitive/rhetorical styles might have in how these works are evaluated in less technical fields.

A different factor that may affect scholars who are in the skirts of academic notoriety is that they might be unaware of how to create narratives about their research that are oriented towards the top-raking scientific community's values. When you are part of this community, you might be better at creating these stories, but you can also choose to ignore their values. The problem can affect some low-ranking scholars is that they do not even know what the values are, thus they do not have a choice in how to report their research. It is needless to say that we are not instructed about all of these issues, we unconsciously do our best to find our places in science.

Moreover, the fact that social status affects theories is also pointed out by Singham (2020, p. 243):

> The final decision as to which paradigm emerges victorious is largely determined by the weight of evidence, but also by other factors such as the contemporary social and cultural environment and the persuasive and institutional power of the sides that are competing. A paradigm that manages to claim the allegiance of influential individuals and institutions and thus can influence the flow of resources and attract the next generation of scientists has a better chance of emerging as the victor.

Knowing that our theories are affected by the status of their proponents either in their make up or in their prevalence should make us more aware of what challenges scholars from different backgrounds may face. This type of discussion, of course, is meant to bring out the question of how often we can make a good judgment on what is a good research, paper, and scholar.

## 2.7 Conclusions

To say that any approach to science is correct is to say that we have encountered the holy grail of truth. This would mean that in a few years we would understand most problems, solve them, and know which problems cannot be solved. This would mean the end of science. However, it is hard to see how such an achievement can be. As far as we know, science is fractal, in the sense that every answer leads to more questions.

What we see is a function of the interactions between previous knowledge and the world. The goal of science is to carve away our cognitions so that we can see more. This is not trivial. We cannot see the whole world at once, and not every factor matters just as much. It is a (biased)

challenge to determine what is worth looking at. Sciences, as humans, may also be blind to some aspects of the world. That is what happened when doctors were so sure that ulcers were caused by excess acid. That is also true of some corners of humanities, in which ideology plays a big role in theorizing (cf. SIMAN; SAMPAIO; GONZALEZ-MARQUEZ, 2021). The point is that we all can fail to see the world in a balanced way, that is why, in the least, scientists need each other. That is why we thrive when we have a diversity of minds working on a problem.

Science is a story because it is always a synthesis. In studying an object we do not perceive it objectively and, as the object is usually more complex than our minds can grasp, we need to devise an interpretative framework to explain it. Thus, we deal with approximations of reality. The objects are there, but we infuse them with our own cognitive architectures and metaphors. Sometimes, we have enough knowledge of the world to act effectively, but we lack an ultimate explanation.

When writing a theory, we decide where to draw boundaries between phenomena, the relative weight of aspects of the investigated phenomenon, what aspects are relevant (and should figure in the theory), and what aspects are not. We do it as we interact with the phenomenon, with our own set of previous knowledge, and goals. When we are studying a relatively simple phenomenon, what is insignificant for our theorizing is clear. But for complex phenomena, what is insignificant is not always clear.

When we consider complex systems such as human biology and minds, we know that we cannot reduce minds to atoms. To understand any part of this complex system is to understand how they all interact. Most scholars will work out the connections between a few disciplines or a few issues, but nobody has complete knowledge about everything (GENTNER, 2019). And it is not only that no human mind has access to all knowledge there is about the interconnectedness of mind, body, and environment, but this knowledge is partial, defective, ongoing.

Thus, it is not only the case that we cannot have a non-perspectival knowledge of the world - biased and limited as we are-, it is also the case that we cannot capture the whole world and its interactions. Metaphors, models, and equations help us synthesize the world, but we must agree that slightly different syntheses might be all just as useful and insightful. We must be on guard of whose perspective and syntheses we allow to flourish, what elements go into the syntheses (and what are kept out), and why.

> Perhaps, rather than conceptualizing chaos and materialism as diametrically opposed, it would be more productive to use elements of both philosophies to provide a richer approach to phenomenon at different levels.
> Ayers, 1997.

> In complex systems, many simple parts are irreducibly entwined, and the field of complexity is itself an entwining of many different fields.
> Mitchell, 2009.

## 3. From reductionism to holism: how Complex Systems Science advances our understanding of cognition

If you have had a basic education in science, you are familiar with reductionism. Reductionism is the belief that "a whole can be understood completely if you understand its parts, and the nature of their 'sum.'" (HOFSTADTER, 1979; MITCHELL, 2009, p. ix). If you are a cognitive linguist (generative or the other kind), you probably equate reductionism with the very concept of SCIENCE, unaware of the more recent and difficult science of Complex Systems (GLEICK, 1988; MITCHELL, 2009; TRANQUILLO, 2019). Complex Systems Science - with its new set of concepts, equations, methods, and tools that can be applied to a range of different problems in the world - offers us a new way of thinking about language, metaphors, and cognition[3].

When thinking about the exact sciences, we are all familiar with reductionism's success in explaining regular elements (e.g., crystal lattices) and we are somewhat familiar with the success of chaos theory in explaining randomness (e.g., gas in a duct). The first problem is amenable to linear equations, and the second to a nonlinear one (KRAKAUER, 2020)[4]. From the notorious success of the exact sciences, a myth arises that the objects of study of the Humanities could or should be explained by math and physics. But there are two problems with this reasoning. The first one is that equations describe, they do not explain. The second is that, when dealing with agents and their associated complex products - which can be anything from

[3] It is important to acknowledge that most scholars have not been trained in complex systems thinking. Being there myself, I understand that they believe that only reductionist science is science. They need not only to understand the new terminology, but also to have an explanation about the viability of the field of Complex Systems. This chapter is dedicated to making the dialogue with classic scientists/linguists possible.

[4] Talk available at: https://www.youtube.com/watch?v=B_wA6PYKq3s, accessed in Jan, 2022.

single cells to humans, cognition, society, and language -, no page of elegant equations can account for its workings (KRAKAUER, 2018)[5]. Still inspired by the classical sciences, the Humanities borrows its reductionist thinking in the form of analytical, linear, formal, and essentialist approaches and applies it to many phenomena (classic programs, like Generative Linguistics and Cognitive Linguistics, are reductionist like the classic sciences, only postmodernism breaks away with it). However, it might be the case that complex adaptive systems - all living beings and their cognitive products, like language and metaphors - are different in nature and need a different approach than that which we are most used to.

This is an important idea to entertain: the problems we face in Psychology and Linguistics are NOT related merely to the fact that these are "young sciences" (in comparison with classic Physics). It is the very nature of phenomena that we study that clash with our expectations that cognition and language should be explained in some analogous way as we explain the movement of non-living planets revolving around the sun, or as computers, for that matter. Life is an emergent phenomenon - that is, knowing all the chemicals that compose "life" does not equate to understanding what life is, i.e., life is more than the sum of its parts. Most products that are continuously associated with life, such as cognition, language, and culture, are emergent and complex, as well. The point is that reductionist logic and methods are limited in explaining the many phenomena that interest Biologists, Psychologists, Sociologists, and Linguists.

In studying cognition, language, and metaphors, we have been applying reductionist thinking to create computational and simple models of the mind. These reductionist theories (e.g., Generative Grammar; Construction Grammar, Conceptual Metaphor Theory, etc.) are very useful for making some predictions regarding the phenomena they describe and for creating an idealized model of the mind. But this computational, linear, and reductionist model also limits our understanding of the complexity of what we are trying to explain. In his chapter, we introduce an alternative to these approaches, which is to study language, metaphors, and cognition from a complex systems perspective.

We need theories that are dynamic because cognition and language change over time. Moreover, behavior is shaped by the context, yielding each time considerably different outcomes. We also need theories that account for how language, cognition, and behavior are organized without a central control (i.e., there is no central command generating rules for how

[5] Interview available at: https://www.youtube.com/watch?v=Qo71DQrY6OQ, accessed in Jan, 2018.

we should behave), that is, they are self-organized. This is what we are presenting in this chapter, a complex systems approach to cognition.

There is no single definition of complex systems since this is an interdisciplinary field that studies phenomena that can be approached through different lenses and methods. Here we are focusing on some properties of complex systems that are most relevant to our argument in the thesis. First, we approach phenomena from a "systems" perspective: systems have connected parts that work together. What constitutes a system need not respect traditional notions of borders, for example, sometimes, different humans can operate as one system. The system is said to be complex if they are highly intertwined. Or yet, complex systems are systems:

> [...] in which large networks of components with no central control and simple rules of operation give rise to complex collective behavior, sophisticated information processing, and adaptation via learning or evolution. (Sometimes a differentiation is made between complex adaptive systems, in which adaptation plays a large role, and nonadaptive complex systems, such as a hurricane or a turbulent rushing river [...]). (MITCHELL, 2009, p.4).

Moreover, complex systems are systems that comprise patterns of information that tend to be much larger than what we can deal with, considering our human and computational capacities (i.e., we have limitations on the amount of information we can process or entertain, thus the explanation of phenomena are likely never complete). Complex systems are nonlinear, self-organized, and exhibit emergent properties, which may sometimes hinder our capacity to model information in its totality and even to accurately predict some forms of complex behavior. It is important to be aware of the fact that no current theory can account for the totality of the complex phenomena we study (i.e., cognition, or metaphors as a cognitive phenomenon). Complex systems are interrelated in ways that make it impossible to create clear-cut boundaries (or modules) to separate them - continuity is a key concept in complex systems science (e.g., continuity between species in evolution; between brain regions; between cognitive skills and other phenomena, such as metaphors, grammar, etc.). This is not to say that the artificial boundaries we create are useless, they are great for scientific discussions, but we shouldn't expect them to be unquestionable[6]. Complex systems are dynamic and unfold on different timescales. All these new terminologies will be explained in the following sections.

[6] Many of the separations or contingencies that we create in biology and cognitive science are questionable, for instance: what are the boundaries of an individual (KRAKAUER et al, 2020)? What is the boundary of the self (RASCHLIN, 2017; SPIVEY, 2020)? What is the boundary between abstract and concrete words (cf. BARSALOU, 2020)? Are there boundaries between brain regions (cf. SAPOLSKY, 2017)? The idea that metaphors are in a continuum either with "non-metaphoric language" or among themselves has also been advanced in our field.

Complex systems are sometimes called “dynamic systems” to emphasize that they are not static. Gibbs (2017) states that: “The field of dynamic systems theory, as it is called, seeks to discover the general rules under which self-organized structures appear, the forms that they can take, and the methods of predicting the changes to the structure that will result from changes to the underlying system” (GIBBS, 2017, p.58). Here, we will to these systems as “complex systems” (instead of dynamic) to emphasize the interconnectedness of our research objects.

There are many ways that we could approach the introduction of complex systems science to our readers, which we presume are cognitive linguists. One of them would be to focus on how this science has developed, focusing on important equations and work on computer science or physics. But for that, we recommend reading the works of Mitchell (2009) and Larson-Freeman and Cameron (2008). Then we could emphasize how the equations developed in this field are used in the study of the brain and cognition, showing that the neurons display chaotic behavior and that cognition can be modeled by fractal and other equations (cf. KORN; FAURE, 2003). But equations are not explanations, and no linguist will switch their hierarchical descriptions of language for math - and they should not.

For brevity's sake and to make this discussion pertinent for cognitive scientists and linguists, I will focus on new developments in Biology, because cognition is in part a biological product. Cognition is also a social and psychological product, of course. But discussions in biology have an obvious advantage over psychology and sociology: their objects are - very often - tangible, observable, in the sense that it is easier to argue that their studies on complex systems are not “metaphorical[7]” (AYERS, 1997).

In the following sections, we will explain some concepts from complex systems and how they have been applied in our field. We also discuss more broadly what we hope to explain about metaphors and cognition through a complex system approach. However, it is only in the next chapters that we are going to make a finer complex systems approach to metaphors and cognition. Finally, we discuss the advantages and problems in adopting a complex systems approach in our field.

## 3.1 Philosophical distinctions

To make introductions easier, let us first consider some distinctions between the classic sciences (which is what most of the readers of this thesis will be familiar with) and complex

[7] Because everything we know about cognition is inferred, every model we produce is possibly metaphorical. We could argue that the mind is literally a complex system, but so could the proponents of the “mind-as-a-computer” argue that their explanations are literal.

systems science. We are treating these sciences in general terms, with the sole purpose of situating the reader. We must bear in mind that complex systems science is a young science (born in the 1980s) with most of its ideas still in development. Thus, the generalizations that we are providing here are a rough characterization of the field. Moreover, Complex Systems Science will sometimes make use of some reductionist ideas, thus, the exposition here is merely didactic.

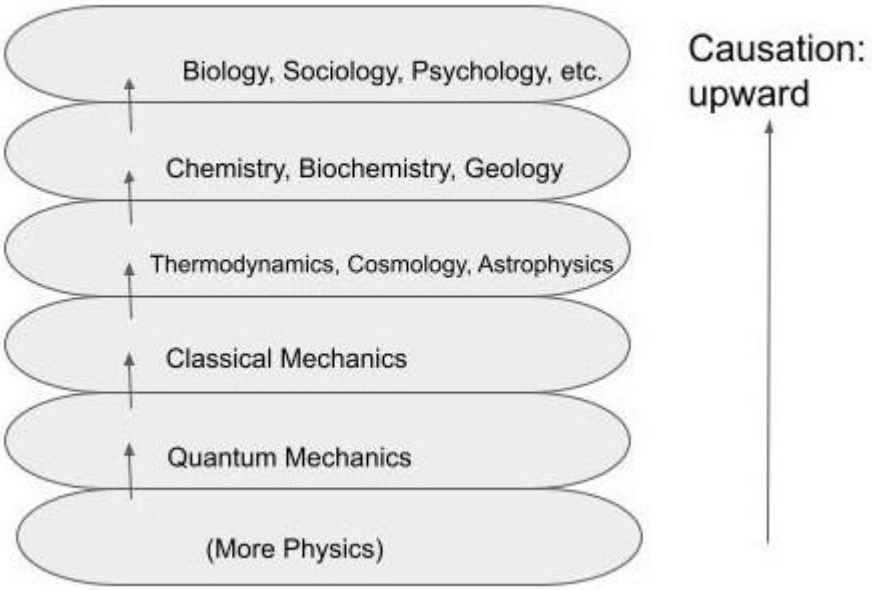
The classic sciences have a realist ontological commitment (i.e., it assumes that reality exists independently from the knowing subject). It also presupposes that reality is deterministic and can be divided into parts and hierarchies. It proposes simple (one phenomenon causes the other) and linear (cause and effects are proportional) causation, and universal laws. Epistemologically, the classic sciences believe it is possible to separate the knower from the object and that their object of study can be completely accounted for by their theories. The methodology of the classical sciences is reductionist and analytical ("divide and conquer"; or "the total is the sum of its parts").

On the other hand, some complex systems scholars believe there is a reality out there, but we may not be able to describe (or even perceive) it properly (see "perspectivism" in chapter 2). Others might believe that we cannot separate the knower from the object studied. As we will see below, when we are grappling with multiple causations that can extend through different timescales, we must realize that maybe we cannot deal with the entire system, which is our object of study. Thus, we are ontologically committed to the claim that the many phenomena in nature are complex systems, but we are aware we might not be able to model the entire system - and that there must be relevant knowledge that we do not yet have about these systems. We also believe some phenomena are deterministic and others not. We propose multiple probabilistic causations (and mutual causality). Nonlinearity (cause and effect are not proportional) is studied in this field. Epistemologically, we might adopt different commitments. A system is more than the sum of its parts, then, reductionist and analytical thought is considered limited (but can be used without the ontological commitments that the system is decomposable in exact parts). Holistic explanations that consider how different parts of the system interact to create a phenomenon are most frequently adopted, but some scholars study universal laws (see more in MORCOL, 2001). In cognitive science, holistic explanation involved accounting for how the body, brain, and environment interact to create cognitive phenomena (instead of focusing only on the brain/mind, as an isolated object).

In the figure below, we see a schematization of reductionist science that can be contrasted with the figure we present in the next section for complex systems. For reductionist

science, causation is univocal and from the inner (or more reductive parts) outwards. On the other hand, for complex systems science, causation is multiple and goes in both directions. For example, genes can affect behavior and behavior can affect genes (as we will see in this chapter); emotions can affect reasoning and reasoning can affect emotions, etc.

Figure 1: Reductionism, the metaphysical thesis that reality is hierarchical and that there is no downward causation[8]




But reductionism is more typical in the humanities in debates where our problems (e.g., language acquisition, metaphor processing, etc.) are explained either by a reduction to cultural causes or by a reduction to a biological or internal set of rules (e.g., Vygotskyan or Chomskyan perspectives on cognition and language) (ALBANO, 1988, 1987). A complex systems approach to our classic problems would demand an interactive approach in which different factors contribute probabilistically to the emergence of the phenomenon under investigation.

## 3.2 Different timescales

Language production (e.g., speech, discourse, conversations, etc.) and comprehension (e.g., listening to someone talk, reading a book, interpreting a poem), metaphoric or otherwise, is a kind of behavior. It is something you do. This might not be everything that language is, but

[8] Available at: https://philosophy-in-figures.tumblr.com/post/93712656521/reductionism, accessed in July, 2021.

it is surely an important part of it. Let's see how the neuroendocrinologist Robert Sapolsky explains behavior from a complex systems perspective. Say John hit Peter and you wonder why it happens. Here is one possible outline of how to explain John's behavior:

> A behavior has just occurred. Why did it happen? Your first category of explanation is going to be a neurobiological one. What went on in that person's brain a second before the behavior happened? Now pull out to a slightly larger field of vision, your next category of explanation, a little earlier in time. What sight, sound, or smell in the previous seconds to minutes triggered the nervous system to produce that behavior? On to the next explanatory category. What hormones acted hours to days earlier to change how responsive that individual was to the sensory stimuli that trigger the nervous system to produce the behavior? And by now you've increased your field of vision to be thinking about neurobiology and the sensory world of our environment and short-term endocrinology in trying to explain what happened. And you just keep expanding. What features of the environment in the prior weeks to years changed the structure and function of that person's brain and thus changed how it responded to those hormones and environmental stimuli? Then you go further back to the childhood of the individual, their fetal environment, then their genetic makeup. And then you increase the view to encompass factors larger than that one individual—how has culture shaped the behavior of people living in that individual's group?—what ecological factors helped shape that culture—expanding and expanding until considering [...] Thus, it is impossible to conclude that a behavior is caused by a gene, a hormone, a childhood trauma, because the second you invoke one type of explanation, you are de facto invoking them all. No buckets. A "neurobiological" or "genetic" or "developmental" explanation for a behavior is just shorthand, an expository convenience for temporarily approaching the whole multifactorial arc from a particular perspective (SAPOLSKY, 2017, p.18).

Under our reductionist ways of thinking, we often want to explain behavior as having one single cause. When asked "why are you crying", we expect to hear "because John was mean to me", not the whole range of factors that got you in that position (e.g., you didn't sleep well last night, what made you a little bit more vulnerable to stress; you are having PMS; and you also had a trauma related to that situation that John has brought up, etc.). When we say that behavior is multifactorial and that the factors are spread into different timescales, ranging from evolutive biases to incidents in your childhood, to things that happened a week ago, or minutes ago, it is hard to get used to this type of explanation. But understanding this is fundamental to the understanding of any behavior, including linguistic ones. **Behaviors are set in motion by multiple causes in multiple timescales.**

This is a diachronic and synchronic explanation of the multiple causes of any behavior. But it is easier to imagine multiple probabilistic causations via a synchronic model. Thus, I will use a probabilistic model to transform something that occurs in different timescales into something momentary. Mary is crying because John said something mean to her, or at least, this is what she tells you. But Mary does not have conscious access to most of her cognition, so

she can't fully explain what is going on with her. To bring different timescales into a probabilistic synchronic model of the mind, let's say that the reason Mary is crying is:

- John said something mean (0.5);
- Mary has got PMS (0.3);
- Mary hasn't slept well and is exhausted (0.1);
- Mary had a related-traumatic experience in her childhood (0.05);
- In Mary's family and culture, it is common to cry when people feel offended (she learned that it is acceptable and expects comfort from others) (0.008);
- John is Mary's boss, so what he says feels very important to Mary (0.02);
- etc.

All of those factors and many others (cultural, individual, etc.) might have contributed even if to a small degree to Mary's crying over John's mean assertion. It is always good to remember that if John had said the exact same thing a week ago, maybe the configuration of factors would have been different enough so that Mary would not have cried. Also, if John had said the exact same thing to Lara because the combination of factors that affects Lara could be different, she would not have cried. Or if someone else had said the same thing to Mary, instead of John, things could have ended up differently. That is, any behavior is the result of various situated interacting constraints. Notice as well that these factors are not deterministic - we are not predicting that every instance of crying during periods must necessarily be constrained by PMS, and so forth. Behavior emerges from the interaction of constraints. This is an idealized example.

There are a couple of observations that justify this multiple timescale analysis of behavior. First, hundreds of scientific discoveries suggest that what we are and do are influenced by hundreds of factors - every scientific field has discovered factors that can affect future behavior. Our political opinions, personality traits, mental dispositions, and diseases all have their roots in evolution, and/or uterine conditions, and/or highly complex interactions between genes and environment, and/or hormonal and neurological changes, all the way up to developmental, environmental, and momentary conditions. There is no ultimate separation between biology, psychology, and society. Insights from all fields contribute to our understanding of behavior under a complex system, multiple timescales analyses. Second, in all sciences (especially in cognitive sciences), empirical findings are very frequently seen as contradictory and irreconcilable, but this is only because the reductionists models that dispute their explanations (e.g., generative grammar or construction grammar) are irreconcilable - we expect that adopting a complex systems perspective will allow for explaining and integrating

important findings. Third, complex systems thinking allows for a change of perspective. If reductionist science expected to explain everything at the lowest level possible (as if social actions could be explained exclusively by molecule interactions in the body), a complex system account makes it possible - even if only at "coarse-grain" syntheses - to contemplate how all levels contribute to behavior, none of them having priority over the other. Boundaries - disciplinary or drawn over human phenomena - are nothing but useful tools for academic discussions.

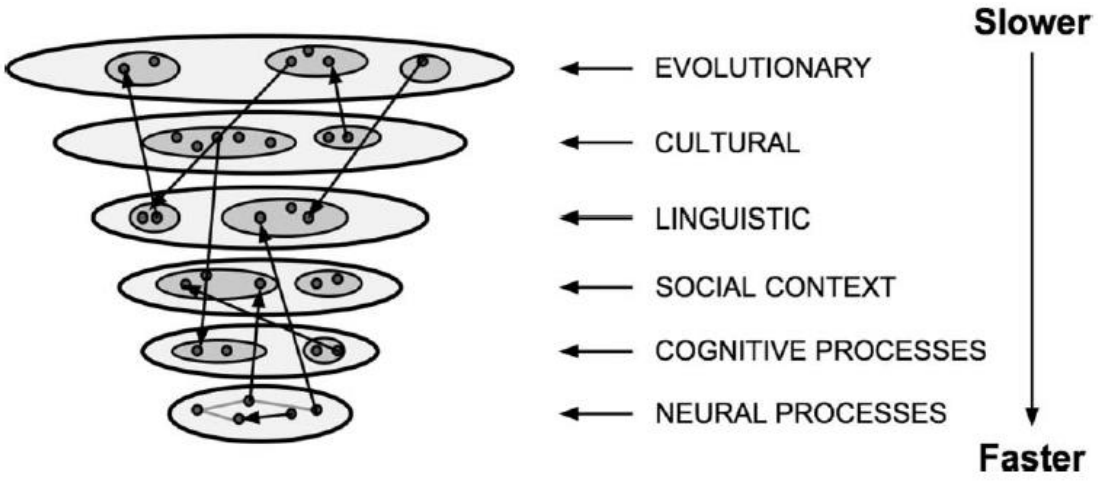
Thus, **multicausality** is a very important concept for complex systems, which refers to the convergence of multiple forces to create behavior. As Perone and Simmering (PERONE; SIMMERING, 2017, p.46) state:

> [...] no single factor is more important than any other—only through the combination of all factors together does causation occur, so it is illogical to consider any given factor in isolation. Proponents of DST [Dynamic Systems Theory] emphasize an appreciation for mutual, bidirectional dependencies between brain and behavior, rather than considering behavior to be driven primarily by a single component (i.e., the brain). This aspect of DST has sometimes been criticized as making research intractable, as it is impossible to measure or control every potential contributing factor. As we illustrate in subsequent sections, however, we contend that multicausality can inform research design, implementation, and interpretation through the questions we ask with our studies, the way in which we gather information, and how we extrapolate from our results.

As we know, language production and comprehension are behaviors. Speaking and reading metaphors are behaviors that are constrained by multiple factors in different timescales (see figure 2). As Gibbs and Santa Cruz (GIBBS; SANTA CRUZ, 2012, p. 304) state about metaphors:

> Under this view, conceptual metaphors are not static representational entities existing only at the cognitive level, but are stabilities in experience that are emergent products of the human self-organized system. Thus, each conceptual metaphoric understanding unfolds over time given the specific contingencies that define any specific discourse situation.

Figure 2: "Multiple Interacting timelines" (GIBBS; SANTA CRUZ, 2012).




In an idealized example, Anna has just said “I am fighting cancer”. What explains this behavior (i.e., this metaphoric utterance)? By now, one already knows that the explanation is not as simple as saying “because Anna activated a conceptual metaphor that is stored in her mind to produce that utterance”. Explanations are a lot more complex, probabilistic, and constrained by multiple factors in different timescales.

As a complex system thought exercise, we will consider a possible way to tackle the metaphor analysis. First, we might want to consider the historical origins of this metaphor. Remember that we are doing a coarse-grain analysis since we cannot simulate or explain events in its totality (further research will uncover all relevant factors that affect behavior). What conditions promoted the emergence of the idea of “fighting a disease”? Reductionists will generally point to one direct cause. They will either say there was some genetic blueprint or that someone in power instructed the use of metaphors. Even though genetics and social power are not excluded from possible complex explanations, they are generally not the only factors involved. When we attribute the emergence of a phenomenon to interacting constraints, we can begin to understand why the same ideas, stories, grammatical forms, and habits emerge in completely different cultures without needing to be controlled by a single mechanism and without people needing to have direct contact with one another.

Ideas, habits, linguistic forms, and metaphors, emerge from the interaction of biological, cultural, and environmental constraints. If you have heard of stories of isolated scholars that make the same discovery independently, you understand that, if people with similar capacities and knowledge are faced with the same problem, they might reach the same conclusions. No human needs to be told (and we don’t need a gene for this) that eating with their hands (instead of their feet) is the best solution to the eating problem. We are faced with the problem, we are

endowed with similar bodies, and we can iterate the eating dynamics until the best solution emerges.

Back to why we say we are "fighting cancer", we have bodies that experience phenomenological changes as we have a disease. For example, when we are sick, our bodies feel weaker, thus, every action takes more "effort" to complete: we are suddenly experiencing a "feeling of opposition" to our bodies (the same gravitational force that always existed, is now felt like an enemy, not because the gravity changed, but because we are weaker for being sick). Being sick threatens our lives, thus, it is valanced as negative in our culture. Because the disease can actually get you killed, it is bad, and you feel weaker having to make so much effort to do the same things that were once "easy", you now have a sense that an evil entity is against you. Wars are prominent characteristics of cultures, so are fights, which are readily available ideas of situations in which you experience a physical struggle with an enemy (we all read about Wars, but we also have embodied experiences with fights - even if pretend fights - when we are kids). Surely, we might account for the fact that our cultures are dominated by rich men, and their power in culture (and interest in wars) might have helped establish this metaphor. The metaphor emerges from multiple embodied (even phenomenological) and cultural constraints. Therefore, this metaphor feels natural for us, as opposed to some metaphors that people try to impose on us as a substitution. Metaphors emerge from our experiences that are affected by our bodies, environments, cultures, etc. No single cause is more important than the other.

It is likely that the metaphor feels "apt" for people because they have to some degree experienced these phenomenological alterations, even though not everyone needs to experience them (some people are just constrained by what other people in their culture are saying), and surely, these factors do not need to be at play at all moments when we produce and comprehend the metaphor (because every metaphor production/comprehension is constrained by situational factors)[9]. It is absolutely not necessary that everyone experiences the same constraints, because once enough people are using the metaphor, other people will adhere. Metaphors do not need to be explained by the same mechanism for everyone or even for every context. We do not need ONE explanation; explanations depend on situated constraints.

If we want to cover why a person has uttered a metaphor, we need to account for what happened in her immediate context (has her interlocutor just used a War metaphor? Has she recently watched a war movie? Does she personally like War metaphors? etc.). Reductionist science cannot explain any individual utterance because it is generic. Knowing what generally

[9] Metaphor processing will be explained in the next couple of chapters.

affects people's utterances allows us to make informative, but probabilistic analyses (SIMAN; SAMPAIO, 2021).

When we talk about how people with similar knowledge, cognition, and bodies can generate similar solutions to problems, one question that is often asked is "then why do metaphors differ in different cultures". If all humans experience changes in temperature in their bodies when they feel anger, why then not every culture conceptualizes anger as hot fluids in a container (e.g., "I am boiling mad", "I am fuming")? There are different biases that operate in different cultures. For instance, Chinese culture already has a strong cultural model to explain emotions, and it is an empirical question of what kinds of bodily changes are encouraged to be shared/talked about in their culture (KÖVECSES, 2015). Different factors have different weights, producing different context-sensitive outcomes. Cultures emerge from the interaction between brains, bodies, environments, and previous knowledge systems. Their products feedback probabilistically into the system to create other differences between cultures.

## 3.3 Self-organization, emergence, and non-linearity

There are many important emergent phenomena in nature that science still does not fully understand. How life on Earth could have emerged from abiotic components is an enduring interdisciplinary question, as put by Krakauer et al. (KRAKAUER *et al.*, 2020, p. 209):

> From the perspective of physics and chemistry, biological life is surprising. There is no physical or chemical theory from which we can predict biology, and yet if we break down any biological system into its elementary constituents, there is no chemistry or physics remaining unaccounted for (Gell-Mann 1995). The fact that physics and chemistry are universal—ongoing in stars, solar systems, and galaxies—whereas to the best of our knowledge biology is exclusively a property of earth, supports the view that life is emergent.

How human cognition, thought, and language emerges is just as puzzling for scientists. An **emergent** phenomenon is that which cannot be explained by the sum of its components, it is a novel structure self-organized from interacting constraints. Knowing the components of an emergent phenomenon does not equal knowing how to create the phenomenon, because we simply cannot account for all the interactions between the components (e.g., life). The problem in pursuing this line of explication for life (and cognition) is that it is hard to experimentally duplicate the phenomenon. And we do not understand the initial conditions much less all the other exact constraints/interactions that might have affected the course of life. Quite often, it is

hard to duplicate the exact conditions for any complex system since the kind of phenomena we study are unique.

We can always look at emergent phenomena in shorter timescales to understand how they work. Unfortunately, we will be looking at physical systems, and, for sure, we will find no origin of life, cognition, or language in there. Let's consider how snowflakes get their emergent unique forms:

> Snowflakes are notable for their individual uniqueness and beautiful, intricate lattice structure. We know a great deal about water molecules, and the shapes of ice crystals and snowflakes, as well as under what conditions of temperature, pressure, and humidity these shapes appear. Snowflake formation begins when water condenses on microscopic dust grains. A large flake's unique structure is caused by chemical reactions and everchanging temperatures. But what makes the exact shape and design of snowflakes? Computer simulations show that the lattice structure of a snowflake can evolve via the exchange of thermal energy from one water molecule to another. This simple system triggers a process in which water nonlinearly transforms droplets into snowflakes, with each one differing because of specific environmental conditions. Snowflakes come into being from the self-assembly of nonlinear interactions of components, none of which prescribe in advance new states of organization that give rise to unique, and most beautiful, forms (GIBBS, 2017, p. 350).

To give another example of emergent behavior, let's consider **swarm intelligence**, which is a type of problem-solving capacity that is not found in one single organism but in the way multiple organisms interact. That is, if you take each organism in isolation, they cannot solve the problem, but multiple organisms, following simple "rules", plus, having the chance to randomly interact over long periods of time will find optimal solutions to their survival problems. They do this without any of the organisms having a blueprint - that is why their behavior is self-organized. If you take one ant in isolation, there is not much it can do. If you take 10 ants, nothing changes. But when you get hundreds of ants together, their collective behavior starts to self-organize creating an emergent global phenomenon that cannot be achieved with smaller quantities of ants. "More is different". When we have enough ants randomly walking around and following a simple rules like "follow pheromone trails" and "reinforce the pheromone trail". Each can choose to follow the pheromone trail or not, and they are more likely to follow if the trail is strong. Ants who end up finding the shorter path to their food source will return home quickly, thus reinforcing the shorter path (moreover, the longer trails will lead to evaporation of pheromone, making it weak). When enough ants follow the pheromone on the shorter trail, they also reinforce it, causing more ants to adhere to the pathway, thus, intelligently solving a problem, without any of them being in charge of the operation.

Emergent phenomena are said to be **self-organized,** as opposed to being controlled by "something that generates rules". As Gibbs (GIBBS; COLSTON, 2012, p. 336) explains:

> Any system can be said to self-organize whose structure is not imposed from outside forces or from internal blueprints alone (e.g. internal mental representations). Self-organizing systems are capable of creating new structures because their components' linked dynamics are dominated by these interactions instead of by activity of isolated components. Emergent mechanisms are temporary, or "soft-assembled," because they go away when a dynamic linkage changes sufficiently; they have no separate off-line or dormant status in the components of a system as hard-assembled modules. Soft-assembly operates in a highly context-sensitive fashion, within particular environmental niches, to create the very specific physical patterns and behaviors of living systems.

When it comes to metaphor production or comprehension, what this means is that metaphors are not the realization of a previously stored static schema. Metaphors (as much as grammar, reasoning, or any other cognitive phenomenon) are "soft-assembled", created momentaneously from the interaction of many constraints that operate probabilistically. We hardly ever need to make conscious choices about what grammatical form to use while talking (e.g., Should I use a passive voice now?) or choose between a set of metaphors. We just express what we are thinking. Our fluid metaphoric talking (or understanding) is affected by multiple interacting, self-organizing constraints.

For example, your use of a metaphor at the moment might be affected by (remember that no factor is deterministic): if you have recently heard that metaphor (a priming effect); your personal preference for that metaphor; if that is a metaphor that is frequently used in that situation; who the listener is (e.g., a kid, a person who likes to climb, etc. - the knowledge you have about your addressee might make it more likely that some metaphors will emerge) or other environmental items (e.g., if there are many war items in the room, maybe they will prime war metaphors); whether you are male or female, or your age group (e.g., some metaphors might be more likely used by elderly than youngsters, or by women than by men), the types and intensity of emotions you are experiencing when you speak (obviously, negative emotions will more likely yield negatively valanced metaphors) - see more in (GIBBS, 2013). The idea here is that no single factor determines metaphor use; the combination of factors is contextual and takes into account the individual's history up to the moment of speaking; speaking is self-organized without internal computational rules. This analysis could have spread out all the way back to other timescales (developmental, historical, evolutionary, etc. - as we have seen in the previous section), but this is only a rough sketch of how the mind works without a central command.

A **nonlinear system** is one that exhibits sudden disproportional changes. For example, the rate at which we learn new words in a second language starts slowly up to a point that there

are sudden changes in the number of words we learn (LARSEN-FREEMAN; CAMERON, 2008). As Larsen-Freeman and Cameron (2008, p. 31) explain: “In a non-linear system, the elements or agents are not independent, and relations or interactions between elements are not fixed but may themselves change”. Perone and Simmering (2017, p. 46) add that: “Systems are *open* to the environment, which means that external forces can shift the components of a system into a new way of interacting, which can often be *nonlinear*.”

For metaphors, nonlinearity can be seen when small interactive changes result in opposite outcomes. In Elmore and Luna-Lucero’s (2017) experiment, the metaphor of “lightbulb” (which emphasizes sudden insights) positively influences people’s judgment that an invention conceived by a man is a genius idea. On the other hand, by switching only the sex of the inventor, the effect is the opposite: the idea is deemed not a genius. The “seed” metaphor (which emphasizes “effort”) exhibits the opposite effect for the sexes, increasing the judgments of geniality for women and decreasing it for men. Thus, it would be wrong to predict that metaphors always affect cognition in the same (e.g., positive) way.

In studying language and cognition, a complex system approach will assume that language processing is nonlinear, in the sense that it is not an additive (compositional) phenomenon. Interesting examples that showcase nonlinearity are “linguistic illusions” or the sentence processing that people believe they comprehended it right when, in fact, they failed. Read the sentences below (FERREIRA; YANG, 2019):

(i) “Each day is better than the next.”
(ii) “No head injury is too trivial to be ignored.”
(iii) “This book fills a much-needed gap in the literature.”
(iv) “How many animals of each sort did Moses put on the ark?”

People often trust that there is nothing wrong with how they have interpreted these sentences, but often, they get them wrong. While people think that sentence (i) means “each day is better than the last” (i.e., days are getting better), the sentence is actually saying the opposite (i.e., each day is getting worse). While people think that sentence (ii) means that “no head injury, even if it seems trivial, should be ignored”, the sentence is actually saying that “you should ignore all head injuries, even the ones which are trivial”. While people think that sentence (iii) is saying that “this book fills a gap in the literature”, the sentence is actually saying something like “there is a gap in the literature that is much needed, but the book is filling this

gap". Not to mention that people hardly ever notice that in (iv) it was not Moses that had an ark, but Noah.

One of the ways scholars explain this type of "mistake" is by suggesting that people do not fully engage with the reading of the sentences - they achieve a "good enough" processing. The good-enough approach to language comprehension holds that language processing is sometimes only partial and that semantic representations are often incomplete (FERREIRA et al., 2002). We would hardly agree that people are engaging in a good enough processing, especially, because you can attentively re-read those sentences and still struggle to get the "correct" interpretation. Our preferred interpretation is that sentence processing is nonlinear (instead of combinatorial) and that each segment is attracted toward some attractor basins. Because these sentences are so formulaic, they are strongly attracted to their correct attractors, surpassing the inconvenient meaning (but resulting in a wrong reading of the sentence). That is, because "each day is better than…" is so formulaic, their attractor is so strong that the competing attractor of "next" has little force in comparison until you struggle to find out what is wrong with the sentence. When you read "How many animals did Moses…" the attractor to a biblical story is so strong, that the misnamed character has no force to counteract the prevailing attractor basins. You did read "Moses" very well. But you were attracted to Noah's story anyway because the cues in the sentence were strong enough.

A prediction that we can easily make given the nonlinearity of language is that every so-called level of language processing (e.g., syntactical, semantic, pragmatic, etc.) can be overruled in specific conditions, even if we cannot specify beforehand what these conditions are.

The last concept worth mentioning in this section is that of **sensitivity to initial conditions**. Sensitive dependence on initial conditions means that vague knowledge of the past leads to vague predictions of the future, that is, we cannot predict the exact state of the system. Brains, ecosystems, and the atmosphere are some examples of complex systems that exhibit this sensitivity. Cognitive phenomena are the same. We can predict some of the ways a metaphor tends to be processed, but we cannot predict exactly how each individual will process a metaphor, even if we knew some information about how they tend to process this metaphor. The problem with this type of prediction is that, for instance, say the person was exposed to some object or sentence that could have primed them or biased them differently - this could change this person's tendency to process the metaphor in some way. Thus, since metaphor processing is not deterministic, real-life experiences may affect the outcome of the processing in different ways.

## 3.4 Trajectories and attractor basins: a metaphor for a nonrepresentational mind

Classic cognitive sciences work with the notion that the mind processes representations. Representations, for classic theories, are symbols and structures that are fixed (in some cases, innate). Thus, the mind operates upon these amodal symbols. Nonrepresentational theories oppose the idea that the mind has fixed symbols and fixed structures. This is not meant to say that the mind is devoid of organization, beliefs, or even "maps" of the outside world. While some scholars do go as far as to reject most of the constructs of classic cognitive science, this is not a consensus. Other scholars still work with a vague notion of schemas, for example. But these "representations" are just not an object fixed in the mind, because their realization interacts with different (embodied, environmental, and mental) information. In that sense, the discussion is not about whether the phenomena studied by classic theories exist or not, but about the nature of the mind.

The mind is always in flux. There is no time in which the mind stops and initiates a new process, like a computer would: "[...] even when the brain is cut off from all external input, during sleep or sensory deprivation, it continues to travel from one brief nearly stable state to the next: we dream, or we hallucinate, or we experience a 'stream of consciousness" (SPIVEY, 2007, p. 11). To model some of the complexities of the mind, it can be useful to borrow a metaphor from dynamical systems theory and attractor networks. Thus, we talk about the mind as a high-dimensional space, with attractor basins, and trajectories. As Spivey (2007, p. 33) explains:

> Make no mistake about it, that is the stuff of which human minds are made: brains, bodies, and environments. Trajectories through high-dimensional state spaces are merely convenient ways for scientists to describe, visualize, and model what is going on in those brains, bodies, and environments.

A **high-dimensional** space[10], in computer science, is a way to model information with many attributes. As the name suggests, this space comports information in more dimensions than our 2-D cognitive theories imply, which allows for a more complex and nuanced understanding of cognitive phenomena. To understand what **attractor basins** are, imagine you

[10] In terms of the brain: "To provide a richer description of the brain's activity, Spivey uses a multidimensional state space. Each brain neuron corresponds to one dimension of that space, which thus has a billion or so dimensions. At any given moment, the total state of brain activity corresponds to a single point in the space. Changes in that activity over time then produce trajectories through the space. Regions of the space to which many trajectories go (and where they sort of stay) are called attractor basins. In many contexts a given attractor basin corresponds to a fully developed percept—to a word understood, a face recognized, a stable perceived version of the Necker cube. The attractors are thus very important, but Spivey is even more interested in the trajectories themselves. The basic units of his thinking are events, not states." (NEISSER, 2007 *apud* SPIVEY, 2007, p.viii)

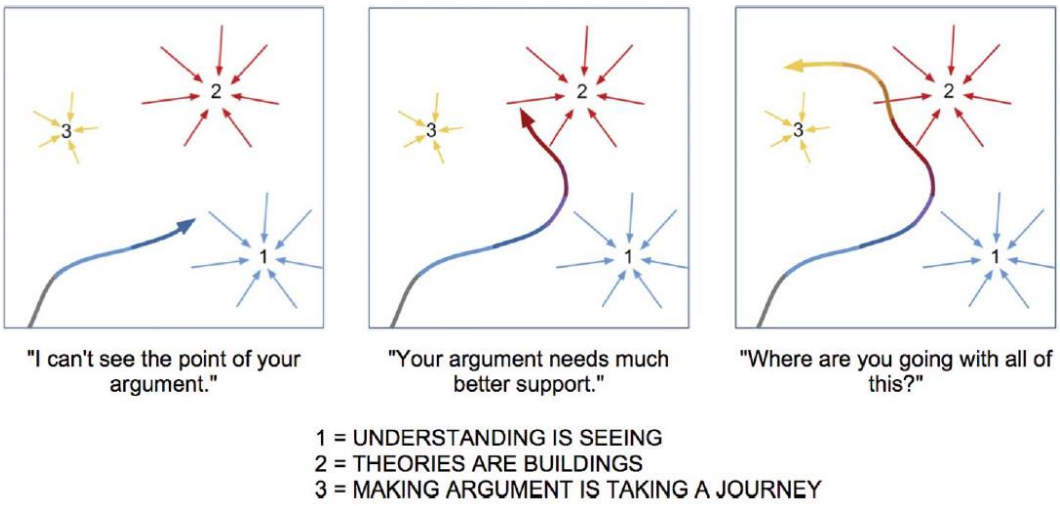
toss a small ball into a round bowl - the ball will swirl around a few times and end up in the middle of the bowl. The middle of the bowl is the attractor. The place around the attractor is the attractor basin, in which the ball makes most of its trajectory. The difference between this example and our explanations about the mind is that in a larger space with multiple attractor basins, the ball (which is a state of mind) would hardly ever fall into an attractor - it would go on through the probabilistic force of multiple attractors. As Spivey (SPIVEY, 2007, p.34) says:

> The important point to be made by the continuity of mind thesis is that these specific locations in state space which seem to have easily labeled identities, these "pure mental states," can only ever be approximated by the actual neural system for which this state space is a metaphor. That is not to say those pure mental states are irrelevant or nonexistent. They do exist, as possible locations in the neural system's state space. They just never happen. The neural population codes get sufficiently activated (i.e., the system approaches close enough to a frequently visited and identifiable attractor basin) to fool everyone—including the self—into thinking that the pure mental state has been perfectly instantiated. However, for this dynamical system comprised of billions of neurons to perfectly instantiate a pure discrete logical symbolic state, such as I am hungry, in exactly the same way every time that state is computed would require more precision than the system is capable of achieving.

The figure below shows how Conceptual Metaphors may be understood not as schemas in the mind, but as attractor basins in a high-dimensional space. The colorful line captures the trajectory, which is processing three metaphoric sentences. It shows that one does not need to access conceptual metaphors in bloc, sequentially. Instead, the mind is probabilistically attracted to one or the other attractor basins in her trajectory, never fully "implementing any of them". The point is to show "how the state of the system over time is mostly intermediate between several different attractor basins and is never fully captured by a single conceptual metaphor" (GIBBS; SANTA CRUZ, 2012). **What we would like to add is that conceptual metaphors are one of the multiple constraints or attractors in the system.** Metaphor meaning is contextual.

It is important to acknowledge that this is an idealized model. Processing a metaphor involves much more complexity and is task-dependent (or context-dependent). Processing a conceptual metaphor (or the linguistic instantiation of it) may not necessarily involve conceptual metaphors.

Figure 3: trajectories through state spaces (GIBBS; SANTA CRUZ, 2012, p. 306).




3.5 What Complex System thinking explains about metaphors

All other cognitive theories about metaphors (within traditional Cognitive Linguistics or Psychology) that you might have learned are reductionist. They aim at a generic description of the mind. Generic descriptions are highly abstract and idealized in the sense that it is meant to capture either “some universal processing mode” (i.e., something that everybody does) or something that is an “idealized mind” (i.e., everyone might not be doing exactly the same but this characterization is the best we can do in generic terms).

On the other hand, complex systems approaches to metaphors are situated, in the sense that it aims at capturing the multiple contextual factors that constrain and give rise to metaphoric utterances and interpretations. In this sense, metaphor productions and comprehension occur in the interactions between factors, such as:

i) conceptual: from previous experiences processing metaphors by cross-domain mappings.

(ii) individual: the experiences of each individual with the metaphors they have been more or less exposed to in a culture - people’s minds are unique. This can be broken down into tendencies that can be found in different age groups, different sex, different neurological make-up, different personalities, different ideologies, etc.

(iii) linguistic: metaphor may appear in different grammatical forms, which can affect its meaning. Most notably, similes and metaphors can be processed differently (BOWDLE; GENTNER, 2005).

(iv) immediate information: this includes the interaction - or what a person knows about their interactant and what the interactant has recently said; priming effects, information that is available in the context and co-text, etc.

(v) metaphors' characteristics: familiarity, aptness, conventionality, history of previous uses, etc.

None of these factors are deterministic, as we will see in the next chapter.

Moreover, here is a list of what complex system approaches are meant to account for:

**1- Individuality and Sociality:** Cognition, language, and metaphor use is individual (because each individual has its own history or its own experiences with metaphors, which gives them a unique metaphoric experience) - contrast that with reductionist theories that account for the "mean" of the behavior of a generic person. At the same time, contrary to reductionist approaches, complex systems account for the fact that the mind is not encapsulated in the head. This means that the mind forms a system by coupling with other people, so the mind is inherently social (GIBBS, 2013). In practical terms, this means that no metaphoric meaning is ever the same, either for two different people or for the same person in different situations. It is clear that the difference in meaning does not need to be extreme, since metaphoric meaning tends to be pulled by attractor basins (roughly speaking, they tend to be attracted toward some meanings, e.g., the most frequent ones or the most appropriate to some conditions).

**2- Phenomenological and sensorimotor aspects of meaning:** Reductionist theories have a problem with phenomenological and sensorimotor aspects of meaning for a couple of reasons: they are not generic, and they might not be present in most conditions. Traditional theories cannot deal with specificity and with variability. For example, the generic description of a metaphor like "We reached a dead-end street" must be very abstract, something like "lovers map to travelers, difficulties map to obstacles, etc." If you ask traditional Conceptual Metaphor Theory (LAKOFF; JOHNSON, 1980) scholars about mappings between our experience of being frustrated both during bad relationships and when arriving at real dead-end streets, the theory cannot give you an account of these mappings. That is because, frequently, "frustration" might not be a part of the meaning of the metaphor. Traditional theories cannot account for specificities, complex systems can because meaning is constrained by multiple factors - phenomenology included. Moreover, in neurosciences, debates over whether sensorimotor components of meaning are a part of the meaning of literal and metaphoric words/sentences are controversial. For one thing, sensorimotor mechanisms are not always recruited for meaning. The variability of conditions in which they may or may not occur is seen by dynamic theories, not as something to be ignored or dismissed, but to be accounted for: we may need to recruit

sensorimotor information in some contexts and not in others. Experiments can elucidate the conditions under which we need them.

**3- Different modes of processing (or different meanings):** From a complex system perspective the meaning of a metaphor involves more than experiments capture since meaning is always not a function of one single mechanism, but of multiple attractor basins. The divergent findings in the empirical literature (cf. HOLYOAK; STAMENKOVIĆ, 2018) show that metaphors might be processed by cross-domain mappings - as predicted by Conceptual Metaphor Theory (LAKOFF; JOHNSON, 1980) -, cf. Gibbs (2017), Thibodeau and Durgin (2008). But they also show that metaphors are processed merely by accessing their shared attributes - as predicted by Glucksberg, 2008). Once we prioritize the findings, without being ontologically committed to computational theories, complex systems approaches can elucidate how the meaning of metaphors can change in different contexts: we just need to test what conditions allow for differences in meaning that are more consistent with one theory or another. Attractors are not mutually exclusive: they contribute probabilistically for meaning. On the multiple interacting forces that contribute to meaning in different situations, Gibbs and Perlman (GIBBS; PERLMAN, 2008, p.217) wisely advise:

> Do not assume that complex meanings require complex mental processes to produce or understand those meanings. People may be able to correctly infer what a linguistic expression means without having to engage in complex psychological processing because of the familiarity and/or frequency of the individual words and expressions. People may learn and correctly understand the complex meanings of many words and expressions by various means that have little to do with the possible cognitive motivation for such speech within a linguistic community (Langacker 1987). Acknowledge these other forces, such as historical convention, cultural norms, and social context, as relevant reasons for why people speak and understand as they do, and suggest ways of how these factors may even interact with conceptual schemes in explaining realistic linguistic behavior.

**4- Continuity and gradience**: Cognitive Science studies everything that can elucidate what the mind is, its origins, and its functioning. Cognitive Linguistics, in broad terms, studies the mental aspects of language, its origins, and its functioning. *What is the mind* is a highly controversial question. For traditional cognitive approaches, the mind is something that is inside the head, a computational system that receives inputs from the world, processes them, and produces outputs. Cognition is the computational machinery responsible for information processing: perception, attention, the formation of knowledge, memory, judgment, reasoning, problem-solving, decision making, and language. Language is traditionally studied as representations and rules operated by a computer-like cognition.

For complex systems approaches such as the one introduced here, the mind is a system that emerges from the interactions between the body, environment, and brain. It is a process that unfolds on different timescales rather than on a computer. Because it operates as a system with the environment and other people (by coupling with them), the mind is not merely inside the head (NEWEN; DE BRUIN; GALLAGHER, 2018). Moreover, cognition is a property of living things. All living creatures have some form of cognition, with increasing complexity, from single cells to humans (DAMASIO, 2018; PAOLO; CUFFARI; JAEGHER, 2018). The scope of study of the mind is not only every problem that classic studies have proposed, but larger ones, including, most prominently but not only, the body. The mind emerges in a continuity between body, environment, and brain.

Embodied cognition is a vast field that studies how the body scaffolds cognitive phenomena, like language. Language is not static symbols operated by computational rules, but a self-organized system. Explaining language from a cognitive point of view involves explaining slower-changing systems (what are called "representations" by classic approaches), "faster-changing systems" (or task-dependent "processing"), and all the cognitive capacities we have (traditionally referred to as grammar, analogy, conceptual combinations, etc.). Explaining language through a complex system perspective involves seeing language not as a computational encapsulated device that only humans are endowed with, but as a continuous multifaceted system that builds on our evolutionary background in ever more complex interrelated ways.

Continuity (both within species and within cognitive phenomena) is a key concept in complex systems perspectives. Linguists have been struggling with continuity or gradience between phenomena since Aristotle's times, and it is a methodological choice what to do about this (AARTS, 2004). For example, generativists favor an idealized view of grammar that allows for no gradience:

> [T]he overwhelming evidence is that fuzzy categorization is involved only in the processes dealing with perception or beliefs about the ‘‘external world’’ and that it is not intrinsically involved in the functioning of Grammar. Externalizing processes such as perception and belief must ‘‘reach out,’’ whereas grammatical processes are strictly internal. If fuzziness is a property of externalizing processes only, grammatical processes could very well be strictly classical. It is very important to bear in mind the distinction between the form of the sentence, that is, how it expresses something, and what it expresses. Only the former is relevant to Grammar. (BOUCHARD, 1995, p 36–37 *apud* AARTS, 2004, p. 352).

Traditional theorizing such as Generative Grammar and even Conceptual Metaphor Theory are idealized as fixed sets of knowledge. Dynamic theories presuppose nothing fixed

and no boundaries between interrelated knowledge. We see continuity in metaphors from more metaphorical to less metaphorical, more conventional to less conventional ones (i.e., novel), more familiar to less familiar, and more apt to less apt (more in chapter 5). We also expect continuity in metaphor processing in relation to the amount of knowledge involved (i.e., probabilistic processing). That is, metaphor processing is situated: it makes use of previous knowledge and biases plus contextual interactions. Regarding Conceptual Metaphors, it means that metaphors are not accessed en bloc, as Gibbs and Perlman (2006, p. 216) explain:

> Finally, cognitive linguistic discussions of metaphor understanding typically do not distinguish between different aspects of linguistic experience. The claim that conceptual metaphors are "automatically" accessed during language use does not imply that people always compute, or access en bloc, conceptual metaphors when interpreting real speech, especially familiar or conventional language. Similarly, complex blending theory analyses of the meanings associated with different metaphorical constructions do not imply that (a) people necessarily infer all those meaning ordinarily during language processing, or (b) engage in the exact set of blending operations posited by the theory, especially, again, when the expressions being understood are conventional. In general, cognitive linguistics accounts of metaphor typically do not acknowledge the complex ways that language understanding can be characterized, ranging from very fast, unconscious comprehension processes to slower, more reflective, interpretation activities (Gibbs 1994).

**5- Stabilities and instabilities:** As Sapolsky and Balt (1996, p. 194) recall: "Intrinsic to reductionism is a view about the nature of variability in data. Some variability is deemed legitimate and interesting, as it reflects as-yet-unrecognized factors in the workings of the system under study", but "other source of variability is little more than an irritant, a problem of measurement instruments—or the humans who use them—not being sufficiently precise; i.e., the variability is simply 'noise' that will decrease with improved instruments." On the other hand, for a complex systems approach, "variability is not mere noise, but is intrinsic to the component parts of the system; moreover, it is independent of the scale of observation" (SAPOLSKY; BALT, 1996, p.194).

In support of the complex systems approach, Sapolsky and Balt conducted a study meant to test the reductionist notion that more reductive methods (e.g., used in studies at a molecular level) yield *less variability* as compared with studies at less reductive levels (e.g., the organism level). The complex system approach would predict that variation is built into all systems, thus, it should remain *constant*. The authors carried out a meta-analysis on papers about the role of testosterone in aggressive behavior produced by different fields, from those that use more reductionist methods (e.g., molecular level) to those that use less reductionist methods (e.g., organism level). By measuring the average coefficient of variation (i.e., each standard error

divided by the mean) in papers from different fields, the authors did not find a decrease in variation for fields that use more reductionist methods. This points to the fact that the reductionist ideal (i.e., the total is equal to the linear sum of its parts), even though it has been so important to progress in science, has great limitations. Moreover, it also helps us understand that the knowledge produced by social or psychological fields will not be reduced to more reductionist fields (either Physics or generative grammar descriptive tools[11], if one may say). Complex systems approaches recognize that the phenomenon we study is highly intertwined and unfolds on different scales, instead of being amenable to formal simplified approaches.

Back to cognition. Some phenomena happen in predictive ways, they are strong attractors. Other phenomena vary more often contextually. Contrary to reductionist science, complex systems approaches do not need to ignore instabilities. Since cognitive processes result from the interaction of different factors when results from experiments are inconsistent with main theoretical approaches, they are not dismissed as "noise", they are plausibly accounted for using our knowledge (gained from other experiments) of how factors may have interacted to produce that result. That is, in all experiments, even if the hypothesis is confirmed, there are often several people that do not conform to the norm. As Gibbs (2010, p.37) says: "When faced with variable data within any experiment [...] psychologists typically explain discrepant findings away as being due to 'error', 'noise', or 'individual differences' without further specifying the nature of these differences". In the same paper, Gibbs explains both the regularities he encountered in a Pragmatics experiment and the irregularities, that is, about 30% of participants did not conform to the general trend. The author proceeded to explain, based on the results of other experiments, what factors may have plausibly accounted for the variation. After all, "Sex, Occupation, IQ, Social status, Language, Culture, Geographic origin, Religion, Political background/beliefs, Ethnicity, Personality, Past, and present bodily experiences, Physiological differences (e.g., brain disorders, disease)" (GIBBS, 2010), etc. may all play a role in how people self-organize when performing a task.

[11] Generative Grammar students believe in the myth that whatever is not explained through Generative Grammar formalism, will be amenable to their treatment in the future. This myth is present in all hegemonic scientific paradigms, especially as a means to dismiss and overlook whatever is not a part of their theories' main interests.

## 3.6 What evidence do we have for complex systems?

Why do we adopt a complex system approach to cognition (and language and metaphors)? Is there evidence to support this approach? Is this a productive field - one that generates hypotheses to be tested?

The first thing that needs to be said is that complex systems, as a field, are not trying to overthrow everything that science has achieved. For example, there is no one trying to deny Darwin's theory of evolution - but we are trying to expand it to accommodate other types of insights and findings. For example, there are experiments that show that traits that are acquired during the life of a parent can be transmitted to the offspring within a generation (a Lamarckian-like finding, but not quite the same, since not all traits can be explained like this). This is called epigenetic inheritance, which is evolution on a short timescale and is being studied by a new field called Evo-Devo (Evolutionary Developmental Biology).

As Wang et al. (WANG; LIU; SUN, 2017) explains, intergenerational epigenetic inheritance is the transmission of epigenetic marks from one generation to the next. That is, generation F0 is exposed to some environmental trigger (e.g., diet, pollution, stress, etc.) that affects their genes, and this effect can be observed in the subsequent generations F1, F2, F3, etc. For example, a mouse can be exposed to some odor, which leads it to acquire a phenotypic trait of “heightened startle response”, then it can transmit this trait to generations F1 and F2, which is observed by tracking the epigenetic marks of CpG hypomethylation of the *Olfr151* gene (DIAS; RESSLER, 2014; see more in LACAL; VENTURA, 2018; WANG; LIU; SUN, 2017).

Another important idea in the field is that species traits are not caused by a genetic blueprint (genotype-to-phenotype map), but by a series of interacting constraints, both historical and environmental. For example, diet can be one of the factors that regulate phenotype trait expression in fish (DAYAN *et al.*, 2019). We would like to make it clear that classic linguists are generally looking for a blueprint explanation. When faced with a problem (e.g., the evolution of language, the explanation of syntax or metaphors), classic linguists look for a rule that alone governs that problem, they assume there is a blueprint that makes up their object of study. A complex systems’ account of cognition assumes that our object of study can be explained by interacting constraints instead of a single isolated cause.

“Group selection” is another controversial idea that has been gaining popularity (WILSON, 1975). Classic theory of evolution defends that natural selection works only at the level of the individual, by genetic mechanisms (famously known as the “selfish gene”, by Dawkins, 1976) (DAWKINS, 2006). But how can altruism evolve if being always selfish

enhances the chance of each individual's survival? Group selection, *even if it is rare*, is the idea that selection can work at two levels: the individual and the group at the same time.

For example, when ant colonies are densely clustered, competition between colonies is fiercer than within them. Shaffer et al. (SHAFFER *et al.*, 2016)[12] found that in these colonies there are more queens than in colonies that are sparsely distributed in the environment, where competition within colonies is fiercer than between them. This is to say that within colonies more aggressive queens survive longer (i.e., being selfish pays off within colonies), but where there's more competition between colonies, cooperative queens survive longer (i.e., being altruistic pays off in this situation). Rachlin (RACHLIN, 2019, p.3) states that:

> Cooperation among queens was altruistic: Any individual queen had a better chance of survival by being aggressive than by cooperating with other queens, but the group had a better chance of survival if that queen cooperated. This is evidence that biological evolution may occur at more than one level.

Wilson and Wilson (WILSON; WILSON, 2008) explain that there are interacting layers of competition and evolution nested within one another (e.g., cellular, individual, group, etc.). At each level, natural selection favors a different set of adaptations. The authors state that: "The general rule is: Adaptation at level *X* requires a corresponding process of selection at level *X* and tends to be undermined by selection at lower levels[13]". What regulates natural selection is the adaptive advantages of a trait/behavior regardless of the level.

In short, the idea is that traits that are advantageous for the survival of the group (in conditions where the group needs to compete with other groups), will increase the chance of survival of that group, so those traits will be selected. This could explain human cooperative behavior, which is necessary for language since language demands a fair amount of trust and cooperation - even if not in absolute cases.

Furthermore, the idea of group selection seems to be compatible with the "extended self" concept (HEERSMINK, 2020; RACHLIN, 2019; SPIVEY, 2020). Classic science sees the self as an "entity", something that is constitutive of the individual. But, as a dynamic system, the self is reconceptualized to be a system coupled with other people that are part of our lives. The boundaries of what constitutes an individual were never the skin (KRAKAUER et al, 2020; Di PAOLO et al., 2018).

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[12] Lab experiments with ants are reported in the same paper.

[13] Available in: https://www.americanscientist.org/article/evolution-for-the-good-of-the-group, access in June, 2021.

The science of complex systems influences different fields, from engineering to social sciences. But what about cognition? When it comes to cognition, there are approaches that show how cognitive phenomena can be modeled by dynamic systems equations (JORDAN; SRINIVASAN; VAN LEEUWEN, 2015). First, we must say that there is no consensus in the field on whether these modeling of cognition can capture the phenomena they describe in their totality - there are scholars who believe that they are offering a complete model, but others believe that no complete understanding of a complex system is at hand at the moment.

The basic idea behind the modeling of cognition as complex systems is to acknowledge how cognitive phenomena can emerge not from internal blueprints, but from numerous interactive constraints (i.e., body, environment, and previous knowledge). For example, a very well-studied phenomenon is the A-not-B test. Piaget (PIAGET, 1954) devised this test to study how children develop what he thought was a "new cognitive structure" that enabled the child to understand object permanence. The test consists of hiding a toy under one of two pieces of cloth placed in front of the child *as it watches*. When one hides the toy twice under cloth A, the child correctly finds the toy. But when the toy is hidden under cloth B, the child under 10-12 months reaches, erroneously, for cloth A to find the toy that had been hidden there previously. This is a very robust finding under very generic conditions. However, with more studies, scholars discovered that this effect is context-sensitive. Smith et al. (1999, p. 236) point out that:

> The literature also reports that the error requires a delay between the hiding event and the infant's action. The error does not occur reliably at any age if the infant is allowed to search immediately after the object is hidden (Diamond, 1985; Gratch, Appel, Evans, LeCompte, & Wright, 1974; P. L. Harris, 1973; Wellman et al., 1987). This, then, is an error that emerges over time, in the wait between seeing the goal disappear and being allowed to act. Further, the delay necessary for the error increases with age: 8-month-olds require a delay of at least 3 s, whereas 10-month-olds require a delay of at least 5 s (Wellman et al., 1987; see also Diamond, 1985). Thus, dynamic changes in memories between hiding and searching appear to be central to the error, and these dynamics change with age.

Importantly for the Dynamic Systems perspective, Perone et al. (2017) explain that the A-not-B error is not caused by a lack of a cognitive structure that is later acquired, but by the combination of multiple factors, such as memory, attention, inhibition, motor planning, posture, and features of the task space. None of these components is more important than the other, and behavior emerges from their interaction in the context. Other important factors that modulate the effect are "visual properties of the hiding locations, their transparency, their number, the

delay between hiding and search, search for people versus objects, and search in the home versus in the laboratory" (SMITH *et al.*, 1999, p.236). Interestingly, infants make the error when the task demands that they reach for the hidden object, not when it demands that they look at the object (HOFSTADTER; REZNICK, 1996).

It is important to acknowledge that many approaches to language and cognition through the perspective of complex systems involve descriptions of phenomena through complex systems concepts and analogies with other well-understood complex systems in nature. These descriptions that are not formal or mathematical are just as important for the field since no model captures everything about a complex system. Adopting a complex systems perspective on cognition also involves the understanding that the results of experiments show only attractors in the systems, not the phenomenon they are meant to explain (i.e., classic approaches to cognition tend to believe in the effects = process fallacy - GIBBS, 2006).

Sometimes, the phenomenon can be better specified and understood using computational tools, like Agent-Based Modeling, which is a computational approach to complex systems. Agent-Based Modeling (ABM) is a computational model that represents how agents (which can have some forms of simplified cognition) interact with others in an environment to create some emergent outcome. The model can be used to specify minimal interactive conditions that can account for complex behavior or predict the behavior of complex systems. In Linguistics, ABMs are used to test hypotheses about how language might have evolved considering the interactions between people (LEKVAM; GAMBÄCK; BUNGUM, 2014; STEELS, 2016), how children acquire language (HOLLAND, 2005), how competing variants of language get settled into the linguistic community, etc. The models do not substitute for empirical research but can incorporate insights from empirical research into a dynamic way of visualizing, thinking, or predicting outcomes.

Complex System thinking does not navigate so easily all levels of information. That is, it can't dispense with other metaphors or intuitions that guide findings in experiments. That is precisely why it also does not necessarily discriminate against other fields' methods and findings - but it also does not commit ontologically to other fields' insights. It does not presume it can make better predictions at all levels, but it can accommodate different findings because it is not ontologically committed to the metaphors or intuitions that led to these findings. Under this perspective, scholars might assume that:

(i) The phenomena we study are intertwined, so we are never going to have a perfect description at one single level or as a modular theory. Mechanistic explanations are useful, but not ontologically real.

(ii) Every time you get a result in an experiment, try twisting the variables involved because often you will find out that you are not dealing with a static finding. For example, for the issue of metaphoric framing effect, you may have three outcomes: metaphors affect people's thoughts; metaphors do nothing; people resist the metaphor. It is a matter of twisting the variables to change these results dynamically. So even though we cannot always predict what variables should be changed to produce some results, as we postulate cognition arises from interactions, we might question what changes are strong enough to make a statistically detectable effect (because some effects all changes are bound to make, even if they are not detectable by statistical tests).

## 3.7 Complex systems science's problems

Complex systems science has brought forth a new set of equations and methods to investigate different phenomena in nature. It challenges our reductionist thinking, as Gleick (1988, p. 5) and others put it: "Relativity eliminated the Newtonian illusion of absolute space and time; quantum theory eliminated the Newtonian dream of a controllable measurement process, and chaos eliminates the Laplacian fantasy of deterministic predictability." But the new science faces its own challenges.

For instance, there is no universal definition of complex systems and not one single way of studying them - some scholars believe that having a single definition misses the point about what complex systems are, and about our human and computational incapacity to describe any complex system in its totality. Very often, complex systems theory deals with phenomena that happen only once, which makes it hard to model or predict them (Tranquillo, 2019).

Whereas there is not a single definition of what science is (GODFREY-SMITH, 2003), to make predictions and to be reproducible is a value held high by scientists. A theory that makes predictions allows for new discoveries; a model that makes predictions allows for controlling the world. And reproducible science means that research needs to have clear methods and data that when analyzed by independent scholars yield the same results - this is what guarantees we can trust the science. But dealing with complex systems might mean dealing with events that only happen once. In cognitive science, it is clear that we cannot predict with accuracy the behavior of single individuals, except for probabilistically.

However, as Tranquillo (2019) notices, the theory of evolution (just as complex systems theories) cannot make microscale predictions. But it does make general predictions at some scales:

> For example, when an invasive species enters a new ecosystem, some general patterns could be predicted about what populations will have the biodiversity to evolve in response. Energy flows can even help predict which populations will be most impacted. The form of the response (e.g., longer beaks, shorter legs, faster digestive capabilities), however, will not be predictable. The same scale-dependent predictive capability also applies to the sandpile— predictions cannot be made about individual grains or the size of an avalanche, but the buildup of tension can be measured. In short, if we care holistically about sandpiles over long periods of time, complex systems theory can be predictive. However, if the goal is to make predictions at the level of sand grains, complex systems theory will fall short. For many of these reasons, Roman Frigg (1972–) has suggested that "theory" does not accurately capture much of complex systems thinking. Rather he suggests that it is a sort of calculus—a series of tools that are helpful in taking apart phenomena out in the world and advancing other disciplines. As a collection of tools and methods, perhaps we should not expect complex systems theory to make predictions and generate refutable hypotheses.

In studying complex systems, we also face the following problem: the real explanation for any system can only be achieved if we know the complete system - which we often do not. Thus, either for lack of knowledge or for lack of human/computational capacity we cannot model the entire system.

A different problem refers to the use of complex systems to studying cognition because, unlike physical systems where one can see the properties, the mind can only be inferred. So even if there are studies focused on patterns of neuronal activity that show chaotic behavior when it comes to the mind, scholars often wonder if complex systems are only a metaphor (AYERS, 1997) - except for when cognitive phenomena are modeled mathematically, in which case, scholars assume it is a literal explanation.

A problem that is even more specific for cognitive theories based on dynamic systems refers to the fact that there are "high-level" structures and processes that have not been fully explained under dynamic/complex perspectives. Most of what happens in language and cognition, again, because it can only be inferred, can be controversial even for dynamic system scholars. For example, there is no consensus on what semantic memory and conceptual combination of grammar are, except that they are not computations.

Complex systems are a young science - if we can call it science at all. At this stage, it is a patchwork of methods, equations, problems, new vocabulary, and analogies, in lack of a unified theory of all complex systems. However, as Mitchell (2009, p.303) observes: "it may be that complexity arises and operates by very different processes in different systems". One may wonder what makes the pursuit of complex systems science worth it, after all. Here are a few reasons to pursue the development of the field:

1. Complex systems science allows for the integration of insights from different disciplines because it does not try to reduce phenomena to a single level of description (e.g., molecular). Of course, trying to cross-cut artificial boundaries between disciplines creates all sorts of challenges. But trying to accomplish this is necessary, even if we might not have the perfect way of achieving it (plus: do you think that classic science has a better chance of unifying phenomena that operate on different scales?).
2. Even though classic science may be more predictive, sometimes, the prediction comes at an obvious cost of verisimilitude. For example, we may create a mathematical model for the Covid-19 spread in which an individual in France has the same chances of getting Covid from its neighbor as from a person living in Australia. The model is good enough for making rough predictions but is completely unrealistic. Using an Agent-Based Model, we can model the spread of Covid by making plausible assumptions about who is more likely to spread it to another person (we can have agents connected as family members, friends, "super-spreaders", a city replica with places that can be crowded or not, etc. The model can also be adapted to the realities of different countries, cultures, etc.). What we mean is that understanding the phenomena is just as important, for complex systems science, as making predictions. Moreover, in cognitive sciences, computational models can make many predictions that complex systems cannot… but what if it is wrong about half of the time?
3. When it comes to cognitive phenomena it is a matter of question whether theories really make predictions or merely act as a license to investigate some phenomenon. They may in fact make "rough predictions". For example, CMT would predict that metaphors affect thought, but it also cannot predict the exact conditions when this will happen and when something else will happen (i.e., resistance to metaphor, or no effect). Generative Grammar is always evolving because it, too, cannot make perfect predictions. Many findings in cognitive science are only partially motivated by theories and partially motivated by intuition or exploration. Even if one might be content with these partial predictions of classic cognitive theories, one must also consider how these theories cannot accommodate much of the current knowledge we have about the adaptive nature of cognition.
4. It is every day clearer that the reductive approaches to cognition are but a rough characterization of the phenomenon. Hardly any cognitive scientist believes that the descriptions they produce map one-to-one to the phenomenon they intend to explain. Complex systems' approach lets us ask: what else should be included as a

characterization of the system if we do not have to believe in the computational metaphors? How do we understand the phenomenon in a dynamic framework?

The science of complex systems is a new field of inquiry and much of its way of working and thinking is not ultimately settled. Its applications to language and cognition are not so strict that cannot be discussed or improved. So, the field is very much a work "in progress". By being informed by increasingly new findings, we hope to devise a better way to approach cognition and language.

From the reductionist perspective, a great problem in the field is pretty much also its strength: complex systems tend not to make "absolute" predictions. What this means is that complex systems do not say "metaphors or syntax will always be processed in a certain way", and they may not even be able to predict the conditions in which metaphor or syntax will be processed in some way as opposed to another. Thus, it feels like nothing ever falsifies the theory.

But, in general terms, complex systems predict that we are not going to find absolute final distinctions between many phenomena, since the phenomena we study are intertwined. It also predicts disruptions, nonlinearities, and exceptions in phenomena, while classic science tries hard to eliminate all of these. As an example, one subject in our experiment said that the metaphor "the price of the meat is high" can be explained by the fact that when something is out of reach, we experience difficulties grabbing it, or we cannot have it (buy it). In traditional analysis, one would have to ignore this participant's response as some act of "nonsense" or noise, because this answer might not reflect "the majority's" answer, it is not generic enough. But the explanation for the metaphor is perfectly reasonable. It might not reveal what people do in online contexts of language comprehension, but as a situated self-organized activity, the participant is resorting to a plausible source of experience to motivate his answer. This is a legit self-organized answer to the task proposed.

As a programmatic suggestion of what to study from the dynamic systems perspective, we would say: all the factors that motivate metaphor use and comprehension. Instead of focusing on semantic schemas, focus on how emotion, embodied, environmental, linguistic, and other factors explain the emergence of metaphors. One can also study metaphors at different scales, when possible (cf. GIBBS; SIMAN, 2021).

## 3.8 Conclusions

In this chapter, we have outlined some of the ways in which adopting a complex systems approach to different phenomena, especially to metaphors, changes how we explain and investigate these phenomena. We have emphasized the contrast between classic science and complex systems science as a way to make it easier to understand that complex systems science brings with it its own equations, methods, tools, and ontological commitments, but it is not - in most cases - trying to overthrow all the knowledge we have gained from the reductionist science. In some cases, it is a matter of expanding our current knowledge by keeping some good insights and empirical evidence but dispelling the ontological commitments of reductionist thinking.

Some of the ideas that we must get used to when considering complex systems science are:

(i) Whereas reductionist thinking emphasizes simple causal explanation (e.g., one cause → one phenomena), complex systems deal with multiple probabilistic causes to phenomena that can be distributed across different timescales. It is not the case that all phenomena must be caused by multiple factors, certainly, there are still simple phenomena in the world.

(ii) Related to what was described in (i), whereas reductionist thinking emphasizes a blueprint type of explanation (e.g., a central rule that commands a behavior), complex systems emphasize self-organization (e.g., how interactions of multiple factors lead to an organized pattern/behavior without "one thing" - a person or a rule - being in control of it).

(iii) Whereas reductionist thinking tends to be linear and additive, complex systems often deal with nonlinear phenomena. Once again, we are not claiming that there are no linear phenomena in the world; systems must be studied on a case-by-case basis.

(iv) Whereas reductionist thinking tries to make up borders between phenomena (e.g., areas of the brain, or syntax/semantic), complex systems science work with intertwined phenomena. We acknowledge the scientific utility of establishing borders, but we are not committed to it since systems operate across any artificial borders.

(v) Whereas reductionist thinking can explain phenomena at a generic level (e.g., why medicine works for most people), it cannot begin to understand why a small group of individuals does not respond to treatment the same way (SAPOLSKY, 2010)[14] - the reason being what one takes to be "equal" across organisms, is not. Complex systems thinking is meant to deal with similarities and differences in systems.

[14] Available at: https://www.youtube.com/watch?v=_njf8jwEGRo, accessed in Jan 2022.

(vi) Whereas reductionist thinking works with “mechanistic explanations” (which we most likely see in chart drawing and the separation of parts of things and their mutual relationships), complex systems approaches tend not to be ontologically committed to mechanisms. It is a question of whether using a mechanistic explanation for systems would be beneficial - even if we do not believe that a mechanistic explanation can cover our object of study (WILSON, 2021).

(vii) As much as we are not ontologically committed to the idea of mechanisms when engaging in a complex systems approach, we also do not commit to the idea that there are “representations” in the mind, even though representations, as much as mechanisms, can be a helpful concept depending on the purpose (SPIVEY, 2008; GIBBS, 2019).

In this chapter, we have covered a few ways that complex systems science advances our understanding of different phenomena in the world, metaphors included. In the next chapters, we are going to be more specific on how to apply complex systems’ thinking to metaphors and cognition.

> This is the next challenge to the current models: they should explain and predict not only the outcomes of the analogy-making process but also its dynamics.
> Kokinov, 1998.

## 4. The self-organization of metaphors

### 4.1 Introduction

*My lawyer is a shark.*

You have just read this metaphor and automatically comprehended it. You did it without any difficulty and without awareness. It does not matter much if you thought this metaphor meant that lawyers are evil, cruel, predatorial, etc. What matters is that you know what it means. Comprehending metaphors is something your mind does automatically. Now read the following one: *Women are like bacon.* Did you understand this metaphor just as easily? If you have never come across it before, I bet your mind did not automatically derive the following meaning: women smell good, taste good, and can kill you. The first is a conventional, apt, metaphor, and the second is a novel and less apt one.

How does your mind process metaphors in the first seconds it encounters them? Cognitive Scientists have been disputing this question for many years. In this chapter, I review some of the main discussions and offer a new perspective on metaphor processing as a self-organized behavior. The main point we make in this chapter is that metaphors are not always processed the same way - and the difference is not only a matter of how conventional they are or what type of metaphor they are, as proposed by Bowdle and Gentner (BOWDLE; GENTNER, 2005). Metaphor processing is the product of numerous interacting factors.

Experiments show that multiple factors interact producing different contextualized interpretations. This process passes through, from the dynamical point of view, objects called “attractors”, which are, roughly speaking, biases (product of previous experience, for example). Importantly, the role of these biases is not deterministic, as communication itself is not deterministic (FUENTES; MIGUEL, 2016).

If we take each metaphor theory in isolation, metaphor processing seems elusive. But when we look at the findings that the psycholinguistics and linguistics research on metaphors has produced through a Dynamical Systems perspective, metaphor processing seems less of a puzzle. Despite the wars against competing perspectives (GIBBS, 2017), most will agree that no current theory can account for the complexity of metaphor processing. For this reason, a couple of pluralistic theories have been proposed to deal with the challenges of empirical findings.

The approximation between competing theories is a much-needed work since it summarizes the state of the art of our scientific knowledge and may lead to new questions and hypotheses. No less relevant is the fact that the integration of findings that resulted from different theories can motivate scholars to change their approaches to metaphors, fomenting developments in different fields. However, the current pluralistic theories have their limitations.

The goal of this chapter is to outline a general approach to metaphors from a Dynamical Systems perspective. Knowing that we cannot give a complete account of metaphors, we propose to integrate the main findings associated with Gentner's, Glucksberg's, Giora's, and Lakoff's theories of metaphors. This chapter also aims to discuss the regularities and irregularities in metaphor processing (GIBBS, 2010). Moreover, by understanding metaphor processing as a self-organized phenomenon, we expect to account for the diversity of behavior in processing metaphors.

## 4.2 Understanding the disputes over metaphors

The question of how we comprehend metaphor involves understanding what mechanism is responsible for its processing and what meanings we derive from it (or what properties of the metaphor are being selected during the interpretative process). In this chapter, we are not going to discuss the whole literature on metaphor processing and theorizing - because it is both impossible and undesirable for the scope of this chapter. We focus, instead, on a few important insights (cf. HOLYOAK; STAMENKOVIĆ, 2018 for a review).

The central theories about metaphor processing propose that metaphors are processed either by categorization (GLUCKSBERG, 2008), lexical disambiguation (GIORA, 2008;

STEEN, Gerard, 2017), cross-domain mappings (LAKOFF; JOHNSON, 1980), or analogy (GENTNER, 1988) - or a combination of mechanisms (BOWDLE; GENTNER, 2005).

Glucksberg's central idea is that metaphors are processed by categorization: “Just as any two concepts or objects can be alike in innumerable ways, so can any two concepts or objects belong to innumerable different categories” (GLUCKSBERG, 2008, p.71). Because Tuna and Sharks share many properties, like living underwater, being vertebrates, and having tails, they are both fish. On the other hand, lawyers and sharks, even if different, also share properties, such as being vicious, aggressive, merciless, etc. They should also belong in the same category, which goes by the name “shark”. The metaphor vehicle is the name of the category, so “shark” has a dual reference. This is not only true of metaphors but also metonymies. The word *Kleenex* has dual reference as well, meaning both facial tissues in general and the specific one from that brand.

The idea that metaphors are categorizations is meant to explain a few things. For example, metaphors are generally easier to understand in metaphor form, as compared to similes (similes should often imply analogy, whereas metaphors would be categorizations). And what is more telling, many of the possible analogical candidates for analogy-making are inhibited during the process of conventional or apt novel metaphors, which is different in similes (GERNSBACHER *et al.*, 2001).

Whereas there is a case to be defended about the differences between similes and metaphors (similes and some novel metaphors seem to be processed in a way, whereas conventional metaphors seem to be different), it is hard to imagine how metaphoric categorization can be achieved without analogy. The argument has been pointed out by Bowdle and Gentner (2005) that in saying *a child is a snowflake,* people mean she is unique, but by saying *youth is a snowflake*, people mean it is ephemeral. If the source and target domains need to interact, they need to have some matching properties (analogy) at some point in time (even if only when they are novel).

Bowdle and Gentner’s (2005) pluralist approach to metaphors - the career of metaphors - emphasizes both Glucksberg’s (2001) findings that suggest categorization is one mode of metaphor processing (more so of conventional metaphors) and Gentner’s (1988) own findings that analogy is also a relevant part of metaphor processing (more so of novel metaphors and similes). The career of metaphors suggests that metaphors are processed as analogy when novel,

then as they become conventional, they are processed by categorization, all the way to the point where they lose the connection with the source domain and become lexicalized. One problem with the theory, among others, is that novel metaphors can be processed in ways other than analogy, especially if they are apt (GLUCKSBERG, 2008).

Conceptual Metaphor Theory (LAKOFF; JOHNSON, 1980), at least in its original form, was meant to explain the systematicity between metaphors (but see novel approaches to conceptual metaphors in GIBBS, 2017; 2019; KOVECSES, 2017). Metaphors like “we are stuck”, “our marriage is on the rocks”, “we are going nowhere” were said to be processed by the same mechanism of cross-domain mappings, in which lovers were mapped onto travelers, relationship onto vehicle, problems onto obstacles, and so on. Even if some research seems to corroborate some of this (GIBBS, 2017), it is also clear that metaphors need not always be processed by cross-domain mappings, such as the case shown by McGlone (1996): the metaphor “my relationship is a rollercoaster ride” evoke paraphrases such as “has ups and downs”, “is exciting”, “is unstable”, etc. Thus, attributes can be more relevant to metaphor processing in some conditions than the mappings Lakoff proposes.

Steen’s proposal, following through with the “career of metaphors”, suggests a “deliberate” and “non-deliberate” distinction between metaphors: the first would be processed by analogy and the latter by categorization. Importantly, conceptual metaphors, in this theory, are regarded as a process that only takes place under “deliberate” conditions, which is the use of metaphors as metaphors. This proposal has been fiercely criticized for many reasons, but especially because metaphors seem to be processed by analogy even in unconscious circumstances, where deliberateness does not seem to occur (e.g., THIBODEAU; BORODITSKY, 2011). Besides, this proposal inherits the problems of the above-mentioned “career of metaphors”.

A pluralist perspective that integrates Conceptual Metaphor Theory (LAKOFF; JOHNSON, 1980) and Relevance Theory (SPERBER; WILSON, 2012) was proposed by Tendahl and Gibbs (TENDAHL; GIBBS, 2008). The authors focus on how conceptual metaphors constrain the meaning of metaphors, but further inferences are needed to derive the appropriate implicatures and explicatures of metaphoric utterances. Other possible constraints to metaphors, especially those that can overrule conceptual metaphors' biases, are not elaborated further in this perspective.

Coulson and Gibbs (2016) sum up different findings that point to how complex and multifactorial metaphor processing is. The authors believe that it is not possible to have a theory of metaphor that accounts for every facet of metaphor processing. Nevertheless, it is the attempt of organizing our knowledge that leads to new predictions, hypotheses, or, if anything, to a synthetic outlook on what we have collectively achieved - a map of where we are at this point. Surely, maps are never complete, and as we further explore uncharted territories, the resolution of the map might change.

So far, theories seem to suggest categorization (GLUCKSBERG, 2008), metonymy (GIBBS, *in press*), and lexical disambiguation (STEEN, 2017) as plausible explanations for how we process conventional and novel apt metaphors. In this chapter, we suggest that the notion of "attractors" is important in improving our understanding of metaphors.

## 4.3 The self-organization of behavior

When we say that metaphor processing is a self-organizing phenomenon, we mean, that there is no central command that generates rules of how to process/interpret metaphors. Moreover, differently from mainstream cognitive science, we consider that the mind is not a computer executing operations on symbols. We also mean that the constructs of "representation", "belief systems", "memory", among others, as used in traditional cognitive sciences are useful approximations, but cognition has no clear-cut distinctions or modules. Our so-called "representations" are self-organized in fragmentary ways, not fixed, and mostly emergent from the interactions between body, brain, and environment (SPIVEY, 2008). Which is another way of saying that meaning is contextual and individual to the extent that the system's historicity is accounted for. But what is more important to this chapter is that metaphor processing is self-organized - or, more specifically, soft-assembled - by the interactions of multiple factors, as this chapter discusses.

Communication, just as metaphor processing, is non-deterministic. This means that we cannot predict exactly what people will interpret from a metaphor. However, metaphor processing has some dynamical attractors (they are not stationary, they evolve in time), which are tendencies in how meaning is construed. Processing metaphors (and language) is not like going through a dictionary and finding meanings. Metaphor's meaning is achieved as our minds travel through a landscape of attractors. When we process language, our minds are pulled

towards different attractors - the stronger and most consistent ones make it into experiments' results and dictionaries. The more variable and weaker attractors color our experience but are hardly ever a part of any theorizing.

### *4.3.1 The self-organization of the mind*

A self-organizing system is one whose structure is not imposed by outside forces or internal blueprints alone (GIBBS, 2016). It is a complex system, composed of many interacting parts producing emergent order. Self-organization, which is a decentralized way systems create organization, is the result of the dynamic interplay between order and chaos. If humans (language or society) were rigid as the computer/ symbolic metaphor proposes, they would not be able to self-organize, produce spontaneous novelty, and adapt to the changes in the world. Only far from equilibrium systems can do all that. Self-organizing systems abound in nature: seeds are self-organized into plants, eggs into chicken, water into snowflakes, and thought into speech - see more about self-organization in chapter 3.

Minds are also self-organized systems because:

> [...] cognition builds on itself, biasing its own outcomes and growing in coherence and complexity. This process is often called self-organization, defined as the emergence of novel structures or levels of organization resulting from the spontaneous synchronization of lower-order elements. At the psychological level of description, self-organizing cognitive wholes emerge from the synchronization of lower-order components, such as associations, expectancies, propositions, percepts, schemas and memories. At the biological level, these abstract entities are translated into populations of neurons and neural assemblies that become rapidly synchronized through electrochemical activities (LEWIS, 2005, p.217).

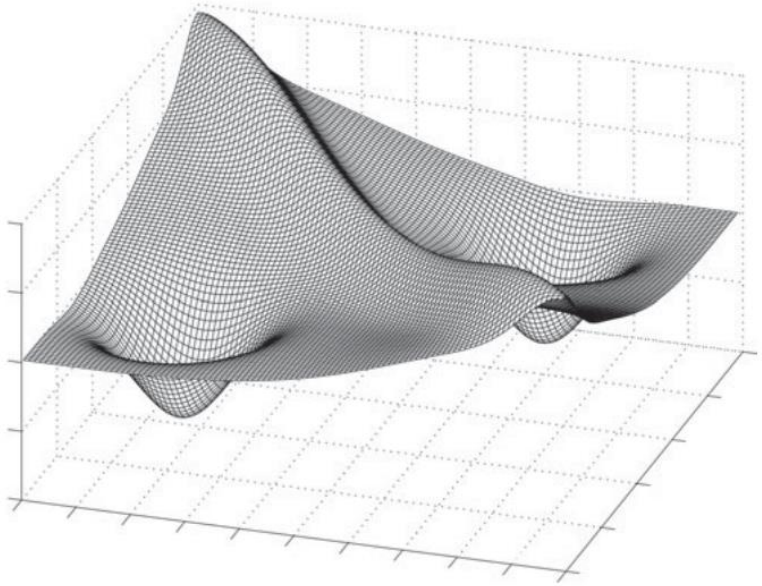
Thus, the mind is self-organized in the sense that it is self-produced from the interactions between body, environment, brain, and other mental structures. But it is also self-organized from moment to moment, as we perform different behaviors. In this sense, another aspect of self-organizing systems is that their organization is set in motion by diachronous and synchronous factors. As Hofkirchner and Schafranek (HOFKIRCHNER; SCHAFRANEK, 2011) state: "The diachronous aspect refers to the evolution of systems, the synchronous aspect to systems' hierarchies." In this paper, we consider metaphor processing a self-organized phenomenon, resulting from the interactions and biases set in motion probabilistically in multiple timescales. Thus, **multicausality** is a very important concept for complex systems, which refers to the convergence of multiple forces to create behavior, in which no single factor is more important than any other (PERONE; SIMMERING, 2017).

To illustrate the concept of multicausality, in accessing an aggressive behavior, e.g., mistaking an umbrella for a gun and shooting someone, one would have to consider a probabilistic causality that encompasses seconds to millions of years that set this behavior in motion. From our biases against men/tall/ethnicity (seconds before) to biases from our body that can be tired/hungry/sleepless (minutes before), to high levels of testosterone (hours before) all the way up to evolutionary times (millions of years before) that made us into a species that is either more or less aggressive (SAPOLSKY, 2017). Numerous factors may contribute to each behavior we produce.

Self-organizing systems produce heterogeneity and unpredictability in behavior, but it also produces identifiable patterns, or tendencies “to behave in a similar way”, which we call "attractors". Biases, or attractor basins, are ways in which our systems tend to self-organize into global patterns, that, once formed, resist perturbations (cf. FUENTES; MIGUEL, 2016; GIBBS.; SANTA CRUZ, 2012; KELSO, 1995; SPIVEY, 2007). Attractor basins are stronger or weaker tendencies that affect our behavior but do not determine it. Its strength can be related to salience, power, importance, frequency, the intensity of the source, etc. (BUI-WRZOSINSKA, 2013).

Under this perspective, the mind is (conceptually speaking) embedded in high-dimensional space (SPIVEY, 2008; GIBBS; SANTA CRUZ, 2012). The attractor basins are multiple, which means that when we process language, there is generally much more information being probabilistically accessed than we are aware of or than experiments will show (experiments tend to focus on stronger attractors). This nuanced trajectory in a high-dimensional space is always unique and colored by people’s personal historicity. Accounting for metaphor processing in a high-dimensional space is also meant to capture the fact that language is not processed by building blocks of sequential information. The concomitant and partial emergent trajectory through a high-dimensional space are always set in motion by the interactions between body, brain, and environment.

Figure 4: An energy landscape (from SPIVEY, 2008, p. 18)



We start our account of metaphor processing by considering the results from experiments that show strong biases (which are tendencies in which the mind self-organizes into possible attractors when processing metaphors), then we will proceed to show how different factors may change the course of processing.

### *4.3.2 How do different attractors affect metaphor processing?*

Language processing and thought are self-organized by the interaction between numerous factors. There is no central command that determines the precise way language must be processed, but some ways are more likely to occur than others. We cannot model all viable interactions that result in processing, but we believe that the following model offers a useful insight into some important factors involved in metaphor processing.

**Figure 5:** The self-organization of metaphor processing

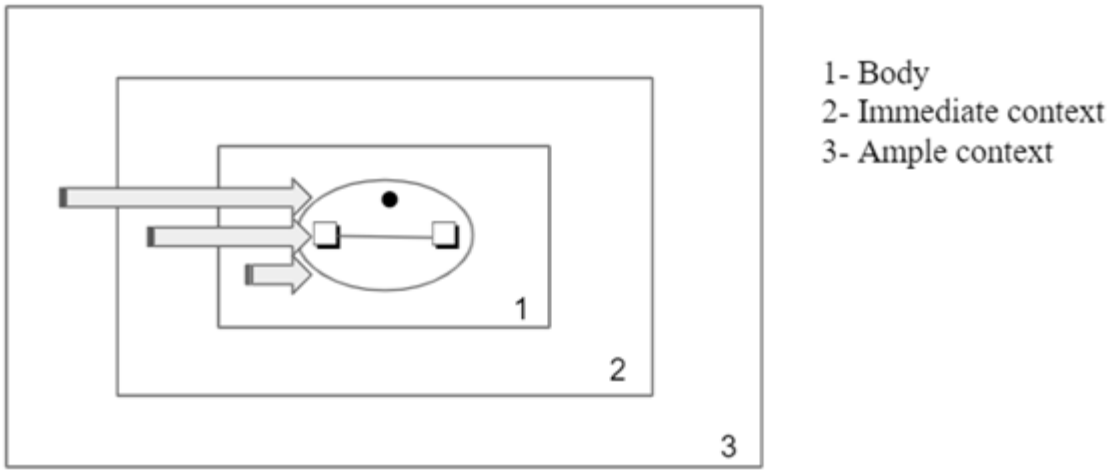



Figure 2 shows how different forces or constraints affect metaphor processing. The circle (where the arrows converge) represents what we refer to metaphorically as a high dimensional space (SPIVEY, 2008). The little squares inside the circle are what we usually call “domains of knowledge”, which are not separate domains, but self-organized knowledge. The line between them should indicate an analogy, but analogies do not always take place during metaphor processing. The dark dot represents an attractor basin (there are usually many attractors, but we are representing one to keep the model concise). The attractor in this case is a bias that the metaphor may have - salient information (literal meaning or metaphoric meaning, or a salient property related to the pairing of the domains or even of the source domain alone). A stronger attractor can overrule the necessity to run an analogy. The attractor is not fixed, but when they are strong, they tend to depend less on the immediate contextual forces. There can be more than one attractor with different forces. That is why sometimes the mind flips back and forth between two senses of a metaphor.

The innermost big square (indicated as number 1) is the realm of the body and its forces on language processing. For example, the action of grasping can affect how we process a subsequent metaphor (e.g., I grasped the meaning) (e.g., WILSON; GIBBS., 2007). It is important to understand that the separations were created for didactic purposes. There are no real separations between these realms - they are continuous and intertwined. The realm of the immediate context (number 2) includes every factor that can affect meaning and that was presented (roughly) in seconds to days earlier: language, text, people, and objects that are

present in the context, ideas one might have heard of recently and that might be salient in one's memory (roughly speaking, this would be the "bottom-up" effects on metaphor processing). For example, language can affect what meaning will emerge during metaphor processing. The realm of ample context (number 3) refers to long-term factors that affect metaphor processing (roughly speaking, the "top-down" effects on processing). Ample context may encompass developmental, cultural, evolutionary biases, etc. Even though distant factors (ample context) tend to be stronger since there are no hierarchies but a heterarchy between them, they can be overruled sometimes. For example, a metaphor may develop a strong attractor from recurrent use.

The insight we want to capture with figures 4 and 5 is that metaphor processing is set in motion by forces in different timescales. The mind is always on a trajectory. The importance of the immediate context is that it can alter the salience of different variables, thus creating different behavior. Differences in our bodies can create different meanings. Moreover, differences in our development, cultures, and other experiences can produce other biases. Surely, our bodies are not so different as to make us aliens to each other, nor our cultures, or our developments. Thus, we can count on having many shared tendencies, but also variability.

The model presented here is a general model. It states that different factors operate in different timescales contributing to creating different types of behavior or different kinds of metaphor processing.

## 4.4 The dynamics of metaphor processing

What we call metaphors might as well be a set of slightly different processes. Notably, dead metaphors, like "blockbuster" (e.g., the movie was a blockbuster), are considered to have lost their metaphoric associations for most people, since many do not know that "blockbusters" were a kind of bomb (GENTNER; BOWDLE, 2008). Some metaphors might be construed differently. For example, I tend to interpret the metaphor "cigarettes are time bombs" to mean that cigarettes will kill you after a while (focusing on time→ death analogy). A participant in my experiment stated that "cigarettes kill you slowly", which focuses on the process of smoking and the time it (and the bomb) takes before they kill. Or yet, it focuses on the context-derived meaning of the metaphor (we know from previous uses what this metaphor means). However, time bombs cannot kill you slowly (they kill you all at once), only cigarettes can kill you slowly

(even though grammarians may not like it). The analogies might focus on different aspects of the domains. However, as we will see here, this is not always the case - some metaphor processing is not even analogical. Besides, we are mostly focusing on metaphor processing in the first seconds we encounter them and on results from experiments. This is by no means a complete account of metaphor comprehension and interpretation.

We take metaphor processing to involve a pairing of source and target domain. The reason this should be considered is that the pairing of forward (e.g., some suburbs are parasites) and reversed (e.g., some parasites are suburbs) metaphors result in the same interference effect, regardless of the conventionality of the vehicle (GENTNER; BOWDLE, 2008; GENTNER; WOLFF, 2000). That is, people quickly understand that a metaphor is meaningful before they can interpret it. The order of the terms seems not to matter at first because the source and target domains are paired, but only later other processes might take over.

After source and target domains are paired, we could suppose that our analogical system runs a search through all possible matches across the domains. But that would in fact be very demanding and not at all plausible. One easy way to know that we do not run a search through all possible matchings is to be faced with creative metaphors and similes. For example, “women are like bacon”. Has your mind automatically figured out the similarities between women and bacon? Probably not (unless you have seen this simile before). Women smell good, taste good, and can kill you. As we can attest, our systems do not just run all viable matchings, some possible matchings are hidden from our processing (and would take more time to “solve it”).

The pairing of two concepts could, in theory, produce any number of analogical matchings. For example, “My job is a jail” could mean my job is “tedious”, “confining”, “keeps me from enjoying my freedom”, “my boss watches me like a like a guard watches a prisoner”, “my co-workers are threatening like prison inmates”, “it makes me feel like I am being punished for something I did wrong”, etc. For “Life is a game”, one could think that “it has winners and losers”, “we make bets”, “we are all players”, “when we die, the game is over”, “there are rules to live by”, “I don’t know the rules”, “it is difficult”, “it is complicated”, “it is fun”, etc. In short, metaphors are generative (WAY, 1991).

But, of course, I am listing these possibilities while I sit in front of a computer, take my time, and think creatively. Reading metaphors in a book or journal, or comprehending what other people say, has other types of constraints. Not only are we not producing every possible

matching, but the domains of knowledge we pair together often have parts of their information inhibited. Glucksberg et al. (GLUCKSBERG; NEWSOME; GOLDVARG, 2001) show that when participants read the metaphor “my lawyer is a shark”, they can quickly process “Geese are cruel”, but take more time to process “Geese can swim”. Thus, it is an indication that the relevant information “cruel” was active when the metaphor was processed, but not the irrelevant (yet plausible) information that both lawyers and sharks can swim.

Thus, it is the case that at any point in time during processing, metaphors mean something either specific or underspecified - but not the whole range of generative cross-domain mappings that the analogy could license. But what exactly does a metaphor mean in context, in the milliseconds we take to understand them?

What they mean is set out by different biases different people have. These biases are given by different factors. Let’s go over some of them.

### *4.4.1 The culturally shared biases: salience as attractors*

Our culturally shared biases are generally related to frequency and relevance. Some things are important because they are frequent (which is another way to say they are relevant) and some things are important because they are relevant (e.g., they are associated with an important group’s viewpoint or with an emotional event). Processing metaphors do not start from a blank page, in which you pair two domains in an empty unbiased mental space. If we had no biases, we would probably, like a machine, run a full search through all possible matchings between both domains, or we would always reach the same interpretation given the same linguistic expression. But this is undesirable, time-consuming, and implausible. Metaphor processing is constrained, and one of the ways it is constrained is by salience (GIORA, 2008), which is achieved either by the frequency that some sense of the metaphor is brought up in use or merely by the relevance of our shared knowledge about the target domain.

We use the word salience to refer to the meaning of a sentence or, within metaphors, to salient properties (in our model salient meaning or properties are attractors basins). For example, when considering the issue of the metaphoric and literal meaning of the sentences, the metaphoric meaning of “spill the beans” (i.e., to reveal a secret) is more salient than its literal counterpart (i.e., to drop the beans) (GIBBS, 1980). For other idiomatic sentences, the literal

meaning will be more salient. Giora (2008) suggests that the salient meaning of a metaphor is always active, even in contexts that do not invite its meaning. For instance, in the text, *Sarit's son and mine went on fighting continuously. Sarit said to me: these delinquents won't let us have a moment of peace*, both the contextually inappropriate meaning (criminal) and contextually appropriate one (kids) are available (PELEG; GIORA; FEIN, 2001).

Interestingly, a less salient meaning can become salient to groups of individuals. As a personal example, my family has developed a bias to quickly pointing out anything that could have a sexual connotation. Thus, even in contexts where the culturally salient and the intended meaning is clearly the non-sexual one, the sexual connotation will be processed just as quickly (if not every time, at least very frequently). One example is the word "food" which can mean both "food" (used as a noun) and "sex" (used as a verb) in the sentence "I like her food".

When considering the issue of what property of the source domain gets mapped to the target domain in metaphor processing, culturally established salience is important. As we mentioned, we do not search through the entire set of possibilities. Let's consider this example. President Trump was on TV and an adult sitting next to me said Trump's hair looks like cotton candy and laughed. The first interpretation that crossed my mind fast and automatically was "white" (notice that knowing the speaker very well and knowing that he is often funny did not help me interpret this metaphor - it seems like the culturally established attractor around it was too strong). Trump's hair and cotton candy are white. But this is not funny, so I tried again. The second idea that crossed my mind was "brittle". Still not funny. I gave up and asked the speaker what he had in mind. He said Trump's forelock looks like cotton candy when it is being swirled around the stick. I would never have guessed that but saw the similarities once it was pointed out. One question would be: how salient must Trump's forelock be to allow for the interpretation intended by the speaker? Or more generally, how salient an attribute must be prior to the metaphor processing so that it will bias processing?

Why was "white" my first and fast interpretation? Older people are generally portrayed as having white hair, this is a salient feature of them (and Trump is included in that category, so he "inherits" the category's salient properties). Cotton candies can be any color, but white is surely a frequent color. In this sense, it is possible that the target domain (e.g., Trump) sets its salient features, which are then matched to the salient features of the source domain. A salient feature is not necessarily a prototypical feature. Salience can be established from frequency within domain or in context (or from the frequency in context).

It is much easier, in case you have never heard this vulgar metaphor, to process it in a salient context than otherwise: “does the carpet match the drapes?” What is the carpet and what is the drape? In the context of a person with salient dyed hair (e.g., red, blond), it should be easier to understand that the dyed hair is the drape and infer from this what the carpet might be. But things are not salient only from standing out (e.g., a beautiful obviously dyed hair). They can be salient for specific individuals (Trump’s ugly hair was salient for my colleague, but not for me). They can be made salient from language (if you talk about them and prime their salience). They can be salient because they were part of important cultural events, cultural implicit knowledge, ideological knowledge, etc. The more salient properties are (in culture and/or context), the easier it should be for processing the metaphor.[15]

Salience bias processing, so that we do not have to start processing a metaphor in an unbiased, blank space (a tabula rasa of processing). This is the case for metaphors like "Youth is a snowflake" (ephemeral) and "Every child is a snowflake" (unique). The matching of properties in these two metaphors is not set up in a blank, unbiased mind. We have cultures that help establish what is relevant about children and youth as to be compared to snowflakes.

Priming effects are a way to set some property as salient. For example, the metaphor “Marriage is an icebox” can be somewhat difficult to understand, but by priming people with the word “cold” or even “warm”, we can constrain the search for a match and make processing faster (GILDEA; GLUCKSBERG, 1983). Priming functions to narrow down what is relevant in “icebox”, that is, not its containing capacity, but its temperature. And by narrowing it down to the temperature we can understand that the marriage is emotionless (cold).

Most telling is the fact that when attractors are too strong for the target domain or the metaphor as a whole, it overrules the necessity of any matchings altogether. For example, in a study in which I asked participants to substitute a metaphoric word for its meaning, participants sometimes substituted "Mary is a **flower**" with "delicate", which both Mary (or a woman) and a flower can be. However, some participants used the word "friendly” or “kind”, which is something one can say about a person but not a flower. But people that are called "flowers" are probably always friendly and kind, thus the frequency that all these situational characteristics

[15] The examples given in this section were instances that I had problems understanding, and as Hofstadter says, the moments that our cognition fail can be informative of how it works.

co-occur might have made the "friendly" and “kind” feature of "flower people" more salient than "delicate". See some examples below:

Sandra is **a flower.**

1A - Substitution:

Sandra is a beautiful, sensitive person, dear [A] [CD] [CD]

Sandra is delicate [A]

Sandra is delicate [A]

Sandra is a delicate person. [A]

Sandra is sweet. [CD]

Sandra is a maiden [CD]

Sandra is gentle/sweet/sensitive [A] [CD] [CD]

Sandra is sweet.[CD]

Sandra is affectionate, cute, sweet, friendly [CD] [CD] [CD] [CD]

Sandra is kind/delicate/lovely. [CD] [A] [CD]

Glucksberg's (2008) research also shows the same type of results, which he called "emergent properties of the topic", contrasting with similes that tend to have fewer of such properties (HASSON, ESTES, GLUCKSBERG, 2001 apud GLUCKSBERG, 2008). It would be strange if using metaphors in similar contexts did not result in any memory of relevant features of the context (i.e., neurons that fire together, wire together). In short, the attractor related to a metaphor, which helps establish its meaning, need not be analogical - especially in the case of conventional metaphors, it can be any salient property of the whole context of the recurrent use of a metaphor. This is important to realize: different metaphors have different careers. Some of them end up being processed by some contextual attractor (i.e., some property that is not typical of both domains, but of the whole context in which the metaphor is used), some of them by some analogical attractors (e.g., attributes, schemas), etc.

When metaphors are conventional, some scholars assume their salient meaning is a lexical entry, which is processed by categorization (BOWDLE; GENTNER, 2005; GLUCKSBERG, 2008). When the salient meaning is activated, other features of both domains can be inhibited (as we mentioned previously in the example of “geese can swim”), which suggests that one is not processing conventional metaphors by analogy. But an alternative explanation is that the frequent use of metaphors allows for gradience in what features are active. Most tests are set for attributive metaphors (e.g., my lawyer is a shark). It is possible that these metaphors have a more stable frequent attribute. But for other metaphors, like those studied by CMT, other features can be gradiently activated, due to their history of variation in meaning. "X is a journey" can mean X is fun/pleasurable (an attribute), as in "Cancer is not a journey, stop the platitudes. Cancer is kidnapping". But it can also mean it has a beginning, middle, and end (a schema), as in "This baby is at the beginning of his journey, an old person is at the end of his". Or a process, as in the song "Life is a journey, not a destination". All of that should be gradiently available, otherwise, we would have problems interpreting the full range of meaning of this metaphor, all of which are conventional, relatively frequent, and variable. Thus, irrelevant information (or information that is not culturally accessed frequently) is inhibited, but some information remains probabilistically available up to a later stage. Gibbs (GIBBS, 2001) suggests that metaphor's meaning is underspecified in some cases.

In sum, we have learned from experiments that salient aspects of metaphors are quickly processed, and this salience is possibly established by frequency or relevance. Properties of metaphors that are generally less culturally salient can turn up to be salient when the immediate context indicates its relevance. We are suggesting here that salient properties are attractor basins in a high dimensional space of probabilistic meanings, in which some of them attract more than others.

At this point, it is worth making a comparison between what we are proposing and the constraint satisfaction model. Gibbs and Colson (2012, p.461) explain this model considers linguistic and nonlinguistic information to make sense of what a speaker is saying. For instance, in deciding if a sentence (e.g., Children are precious gems) is metaphorical (e.g., valuable) or ironic (e.g., burdens), the knowledge that the speaker is often ironic speeds up the ironic interpretation. Moreover, knowing the occupation of the speaker, whether the statement is counterfactual to other information in the discourse, and the familiarity of the expression can affect processing (GIBBS; COLSTON, 2012; PEXMAN; FERRETTI; KATZ, 2000). This is

all in accordance with our self-organizing model. The difference is the focus on how self-organization is set in motion by factors in different timescales. Also, much of the information that should constrain meaning does not always contain meaning, since some attractors might be stronger or weaker in context (i.e., the constraints of the context are not deterministic, see FUENTES; MIGUEL, 2013). Moreover, as Giora (2008) has argued, salient meanings that are not appropriate in context can nevertheless be active, provided they are strong attractors.

### *4.4.2 Changing the attractors*

Experiments tend to exploit culturally shared biases, our shared attractors of behavior. But as we have seen, these biases are not deterministic. There are many ways to (temporarily or not) reset them. Experiments with priming show how different conditions can affect metaphor processing. Thus, even if some metaphors might have some salient meaning or be hard to process, variation in the context can alter how a subsequent metaphor is processed.

For example, even if the metaphor “I grasp the meaning of what you said” is usually processed by accessing a strong attractor, say, “understand”, and even if in some cases sensorimotor information might not be needed to process this metaphor (but see LAI; CURRAN, 2013), we know that action schema may be part of the meaning of the metaphor under some conditions. The facilitation that occurs in priming experiments shows that the general knowledge we have about metaphors is richer than just a categorical attribute can capture. For example, Wilson and Gibbs (2010) asked participants to either perform or imagine some action before reading a metaphor. Results show that performing or imagining actions that are consistent with a metaphor (e.g., performing a "grasp" action before reading "grasp the idea") allows for faster reading of the metaphor. The sensorimotor component of meaning is one among various "properties" that can compose meaning. Wilson and Gibbs' experiment is a priming experiment, and we can prime features in different levels of abstraction (sensorimotor or otherwise). The level of abstraction at which we process sentences depends on the many factors that interact to constrain meaning contextually.

Williams and Bargh (WILLIAMS; BARGH, 2008) show that holding a cup of warm coffee can affect participants' judgments about how effective a character is, which confirms Conceptual Metaphor Theory’s (CMT) proposal that we (sometimes) understand affection as warmth (AFFECTION IS WARMTH). This bias is not seen in a replication of the study outside

the lab (CHABRIS *et al.*, 2019). This is not meant to suggest that we never understand affection as physical warmth, but that there are conditions under which this might happen or not.

Ackerman et al. (ACKERMAN; NOCERA; BARGH, 2010) asked participants to hold a clipboard with a curriculum on it. The weight of the clipboard was manipulated between conditions. Participants who carried a heavier clipboard judged the curriculum to be more important (even though the curriculum was the same in all conditions). This finding supports CMT, which proposes that we understand importance as weight (IMPORTANCE IS WEIGHT). However, if the weight of the clipboard is too heavy, participants might notice something is odd, in which case, the effect is reversed. That is, participants judge the exaggerated heavy curriculum/clipboard to be less important (ZESTCOTT; STONE; LANDAU, 2017).

Attractors can also change culturally. In a famous example, Lakoff and Johnson (1980) report that the metaphor "there is no solution to this problem", which is readily understood as a solution to a puzzle by native Americans, was understood as a solution in a chemical compound by a non-native speaker of English. The implications were relevant: by understanding this metaphor as a chemical one, the listener was prompted to imagine that problems that have no solution are always there, never ceasing to exist, never diluted. Littlemore (LITTLEMORE, 2003, 2001; LITTLEMORE *et al.*, 2011) also discusses how students from different cultures have problems understanding metaphors in English.

Understanding that metaphor processing is self-organized in context and that context can vary in different ways, helps us understand the importance of different experiments' results. It also shifts our mode of thinking. Instead of considering that any variable, e.g., "deliberateness" (STEEN, 2017) could be responsible for major differences in processing, "deliberateness", if anything, will just add one restriction to a self-organizing mind. Metaphor processing happens through the interaction of different personal, cultural, and cognitive biases.

### *4.4.3 Personal and interactional attractors*

Our minds are not only self-organized in overall cultural terms but are also organized in interactions in personal ways. For one thing, we are always being primed one way or another.

Going about life, our experiences that happened earlier in time may often affect how we adjust to the following stimulus.

We also adjust to stimuli based on our interactions. The person we are speaking to is readily categorized in many ways (e.g., as a child or adult, as a member of one group or another, etc.), all of which primes us in ways to modulate our language understanding. If you expect a person to say unfriendly remarks, you are more likely to see her neutral remarks as unfriendly. If you (mis)judge a person to be a member of a hippie epistemic community, you may mistake her use of the word "desire" (meaning "will", in "your desire to explain the totality"), as something psychoanalytical (the author of this text took an extra minute to realize that what the speaker was saying was the most trivial meaning of "desire", instead of something Lacanian). We sometimes adjust for what we perceive from a situation/person, and from what they say to us. In this chapter, we have discussed how knowing, for example, that a speaker tends to be ironic facilitates the processing of a metaphor as being ironic (PEXMAN, FERRETTI, KATZ, 2000). Knowing that a metaphor was written by a poet, instead of generated by a machine, leads people to be more careful in how they interpret metaphors.

Other than that, we have our personal attractors. Gentner shows how kids tend to process metaphors by focusing on attributes, while adults' attractors are relational (GENTNER, 1988). For example, the metaphor "tree trunks are straws" is interpreted by kids as "both are long" and by adults as "both carry water to the top". Besides, traits like "anger" and "procrastination" seem to affect the likelihood that people will adopt an "ego-moving" or "time-moving" perspective on responding to an ambiguous sentence about time (HAUSER, David; CARTER; MEIER, 2009). Colston and Gibbs (2016, p. 466) state that:

> [...] it is critical to recognize that the major findings of different experimental studies do not imply that virtually all people participating in these studies necessarily behave in the same manner, nor does a single person behave the same way throughout the course of a single experiment. For example, various experimental studies have demonstrated that individuals with higher working memory spans and higher IQ scores are better able to draw divergent cross-domain mappings during verbal metaphor processing than are people with more limited working memory spans and lower IQ scores (Chiappe & Chiappe, 2007; Iskandar & Baird, 2014). Similarly, differences in people's executive control also influence the speed with which they read both literal and metaphorical uses of verbs in sentences (Columbus et al., 2015). Individual differences in cognitive capacity give rise to varying results on standard measures of metaphor processing abilities.

*4.4.4 Linguistic and other metaphor attractors*

The question of linguistic biases is often intertwined with novelty, familiarity, and/or aptness of the metaphor. Some of the questions we explore about language and metaphor are:

(i) Differences between grammatical forms of metaphors, e.g., nominal metaphors (e.g., John is a lion), verbal metaphors (e.g., John flew home from school), poetic metaphors (e.g., I heard the thunder gossip) (cf. BLANK, 1988). For example, both nominal metaphors (e.g., The sky is creamy) and modifier metaphors (e.g., creamy sky) yield an interference effect when read, which means that participants process the metaphoric meaning automatically (AL-AZARY; GAGNÉ; SPALDING, 2021).

(ii) Differences between literal and metaphoric language, for example, literal categorization and metaphors of type A is B (cf. GILDEA; GLUCKSBERG, 1983). Conventional and apt novel metaphors tend to be processed as quickly as literal categorizations, which for some authors suggest a similar underlying process.

(iii) Differences between inverted metaphors (e.g., My surgeon is a butcher; My butcher is a surgeon), create different meanings. This may suggest a unidirectionality of metaphor mappings, but Gibbs (*in press*) suggests otherwise. The order of the terms in the metaphor seems to set the relevant properties for processing it, but it is possible that the matched properties are always bidirectional. Gibbs (2015) shows that just as much as political debates are conceptualized as matching boxes, matching boxes are conceptualized as debates. See (KATZ; AL-AZARY, 2017).

(iv) Differences between familiar and unfamiliar, apt and inapt metaphors, etc. For example, Al-Azary and Katz (AL-AZARY; KATZ, 2021) show that low-familiar metaphors prime embodied associate properties, whereas high-familiar ones prime abstract properties.

(v) Differences between similes and metaphors.

Of all these items, the difference between metaphors and similes is explored in much detail, since one of the main questions regarding metaphors is whether they are implicit similes. In some cases, metaphors and similes are not different. But in other cases, similes and metaphors result in different modes of processing.

Novel expressions that contain an adjective modifying the figurative item may result in different interpretations for metaphors and similes. For example, “His job was a secure jail” tends to be interpreted as “unpleasant and confining, but safe”, whereas “His job was like a secure jail” tends to be interpreted as “ unpleasant and confining like a high-security prison” (GLUCKSBERG, 2008; GLUCKSBERG; HAUGHT, 2006). In both cases, the conventional meaning of "my job is a jail" seems to attract the interpretation, as the adjective contributes additional and different content. Moreover, the simile form may sometimes greatly affect the possibility of the sentence being understood as metaphoric. Glucksberg (2008) shows that "My lawyer is a well-paid shark" is readily understood as referring to a metaphoric shark that is well-paid, whereas "My lawyer is like a well-paid shark" leads first to a literal interpretation in which a real shark is well-paid, making it a less apt assertion.

Truly novel metaphors, provided they are not apt, tend to be preferred in the simile form and be processed by analogy (BOWDLE; GENTNER, 2005).

## 4.5 The dynamics of concepts

We have discussed how different attractors affect metaphor processing. These attractors are created by different experiences, through exposure to different types of information (e.g., in different cultures, or different contexts that different individuals are exposed to). Thus, attractors need not be equal to every individual, although some of them can be quite similar (e.g., cultural ones).

In this section, we will explain how concepts are accessed in metaphor processing, considering a dynamic systems perspective. Firstly, we must have in mind that each individual's mind in different conditions will have a different landscape of concepts. Thus, no metaphor processing (and no language processing, more broadly) is equal to the other, although they certainly share attractors (or similarities). “You can’t step in the same river twice”, or: you can’t have the exact same mental landscape twice, although we can have similar attractors. In this sense, the examples we are going to discuss here are all idealized, because all attempts to analyze the mind are idealizations. We don’t read minds, generative linguists don’t read minds, and no one does. The difference between what we propose here (in line with Spivey, 2008), and what traditional cognitive linguistics proposes is that the traditional constructs of linguistics are generic. They are meant to capture a generalization for a given phenomenon (as if context and time did not exist). Here, we are presenting an idealization of an individual mind, not a generic

one. Individual minds are bounded by time, history, context, previous experiences, etc. They are not an abstraction, but we cannot know any individual mind, so we are going to create one based on the dynamic system's theory.

Figure 6: Idealized landscape: domain 1

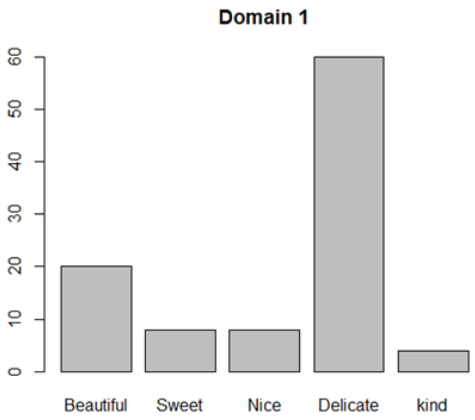



Figure 7: Idealized landscape: domain 2

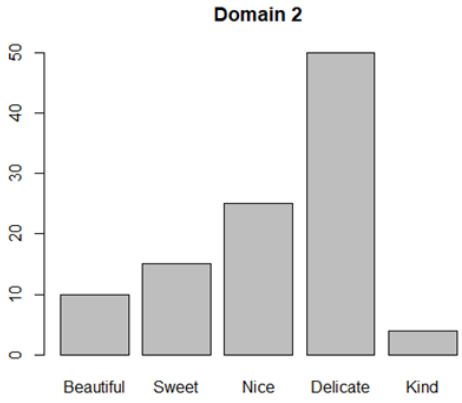
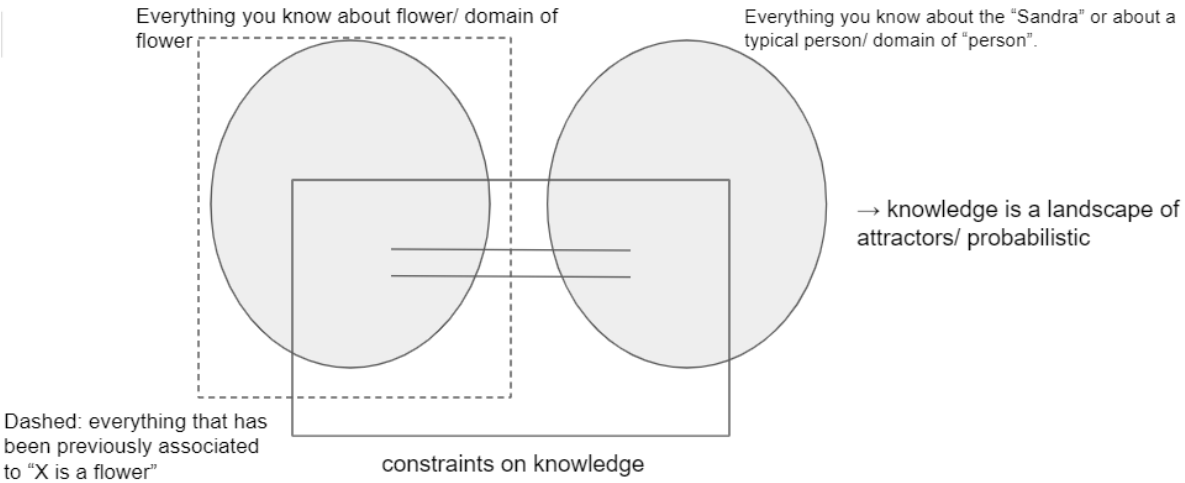



Figure 8: Processing "Sandra is a flower" (a conventional metaphor).



Each mind at each moment is a landscape of processes and attractors. Much more than we can represent here. Thus, our representation here is, of course, a simplification. Figures 6 and 7 represent the idealization of the processing of the metaphor "Sandra is a flower". Consider figure 6 as old information, stored in memory from previous experiences in processing (this is domain 1), and figure 7 as contextual, novel information. Metaphors are always processed in context, there is always some novel information about the entity we are referring to that can be provided in the text or in the situation we are participating in. Figures 7 and 8 show that many concepts contribute partial information to the processing of "Sandra is a flower". In different contexts, different concepts may dominate the processing. In this case, "delicate" is the dominant attractor in the landscape and it matches the contextual information, thus, processing goes smoothly. In the example shown below, domain 1 (Flower) is already affected by the previous processing of the same metaphor "X is a flower", thus it contains more information than a non-metaphoric domain of flower would contain (i.e., literal flowers are generally not said to be kind). Domain 2 is about the other term of the metaphor, in this case, "Sandra". We may know a lot or little about Sandra, and it should affect our landscape.

In this idealization, we know by the context that Sandra is really delicate, very nice, somewhat kind, etc. Remember that this is not a picture of what is happening in the mind. All theories are summarizing, condensing a complex multivariate world into simple equations, graphs, stories, metaphors. The world is more complex than we can grasp. Thus, the figures presented here could be broken down into different aspects, and could show different parts and facets of cognition. We are making a choice to emphasize some aspects that are derived from the results of experiments.

Figure 8 shows that you have the possibility of running cross-domain mappings for this metaphor. Consider that the knowledge you will assess in context is not likely to be everything you know about the domains involved, but they are already probabilistically biased or constrained by many factors (what you know about the speaker, relevant previous information about the topic, etc.). In some cases, because "Sandra is a flower" is a conventional metaphor, cross-domain mappings can be overruled, and the attractor that is part of the semantic memory you have associated with the use of "X is a flower" can create the meaning of the metaphor. Alternatively, you can create cross-domain mappings, depending on the contextual constraints involved. Let's consider a different metaphor: "you are the coffee of my life". Processing it is not the same as mapping all the possible matches between the two domains. Processing is constrained in many ways. It starts by constraining the landscape of what is relevant to the situation we are talking about. Let's say the metaphor was said by someone who loves coffee

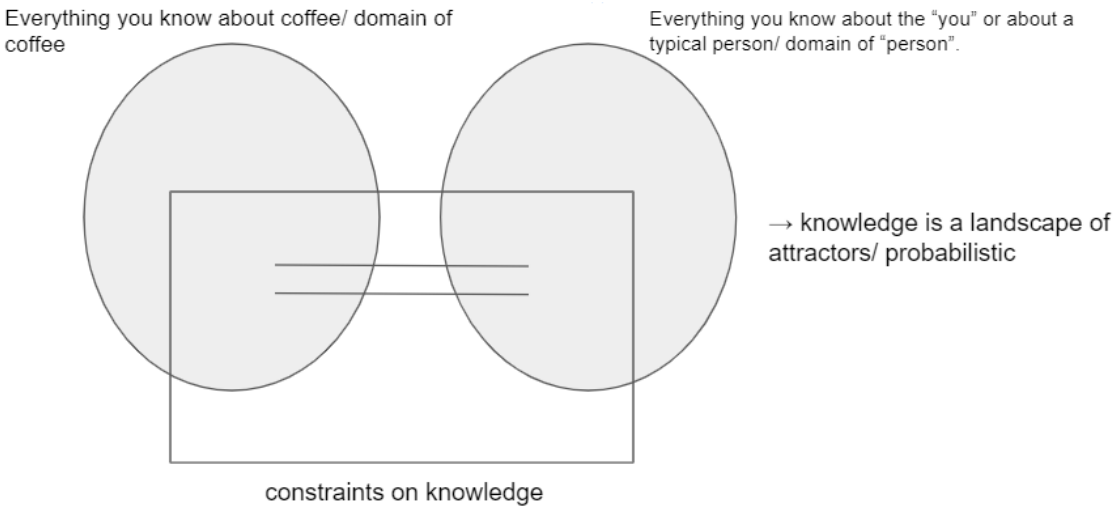
for someone who knows that the speaker loves coffee and knows that the speaker is found of him. Thus, this listener does not have to run a search through everything he knows about coffee, his landscape of concepts/ideas about coffee is his previous knowledge about what is relevant to this situation: the speaker loves coffee, loves the listener, and is not being ironic. Thus, the meaning of the metaphor is something like "you are something I love so much, that fuels my day, etc.". The exact meaning of the metaphor also depends on what you know (particularly) about coffee. Your experience with coffee makes some of its properties more salient than others.

Now lets' say that the listener knows nothing about the speaker's taste for coffee, but he knows that many people in our culture love coffee, and he knows (because of the previous contexts, interactions, and the speaker's intonation – all of which are constraints –, that the speaker is trying to remark something nice). In this case, he knows the meaning of the metaphor is something like: "you are something I like, you are so important".

Another example: let's say the listener knows the speaker does not like coffee. But let's also say that culturally coffee is something that most people appreciate. In this case, it is likely that the speaker will derive two meanings, one which is appropriate for the situation and the other which is not appropriate. The appropriate one is: "I don't like you", but – just like Giora (2008) has pointed out – the inappropriate meaning of "I love you/I love coffee" is likely to be active, even if completely inappropriate, just because culture is a strong constrain in this case.

As the last example, let's say that in the previous context, the listener had been saying something "bitter". Then this metaphor would be contained by this precious context to mean "you are bitter". This metaphor can potentially mean many other different things, provided that the context can vary. The previous situations can vary, the speakers can vary, what they know about each other can vary, the intonation can vary, the grammar can vary, etc. Thus, the constraints on meaning can vary, that is why the meaning of the metaphor can vary. It is important to highlight that none of these constraints are deterministic. Figure 9 represents the full set of knowledge you have about both domains in a metaphor, and how you don't access the full knowledge, just what is biased or constrained by the context.

Figure 9: Processing “You are my coffee” (a novel metaphor).




There are two more things important to add. One is that all of this happens in flux, or in a continuum (as we are going to explain in the next chapter). The illustrations represent static and separated objects, but this is just for convenience. The other issue we would like to quickly address is how conceptual metaphors (LAKOFF; JOHNSON, 1980) are biases that constrain (probabilistically, not deterministically) meaning. We will discuss these metaphors in chapter 6.

Understanding metaphor processing mainly involves understanding what the mechanism is responsible for processing and what is (or what are) the meaning(s) of metaphors (or what are the properties selected for metaphor meaning). The approach that we briefly presented here is a novel approach, which differs from other approaches in that it is dynamic, in which the factors that constrain meaning are modulated by the context, and the mechanism is selected based on the history of each metaphor, which can be analogical or a conventional attractor. It is important to consider that the factors that constrain meaning are probabilistically making some properties of the domain active.

This approach can be contrasted, for example, with the Conceptual Metaphor Theory, which proposes that the processing mechanism is always the same and the mappings are always the same. This approach also differs from models that claim that the mappings occur because of previous similarities between the two domains involved. These proposals focus on semantic domains isolated from their contexts (ORTONY, 1979). In our approach, the salience of properties is articulated, for example, through cultural, individual, or immediate experiences, etc. It is a dynamic approach, not a fixed one. Therefore, we can interpret the same metaphor in different ways in different contexts. Also, consider the metaphor “children are snowflakes”.

Brazilians may have difficulty interpreting this metaphor as meaning “children are unique” even though they know that children are unique and snowflakes are unique. This is because “unique” is not a culturally established property (or not culturally relevant) for either “snow” or “child”. Of course, an immediate context could facilitate the processing of this metaphor.

Furthermore, for Glucksberg et al. (1997) metaphors are processed by categorization, in which one of the domains offers categories and the other selects dimensions of applicability. As already pointed out by Bowdle and Gentner (2005), the problem with this approach is that the domains involved can offer a large number of categories. For example, snowflakes are ephemeral, white, wintery things, pretty, icy, etc. The person processing the metaphor would be overwhelmed by so many categories until the other domain selects the applicability dimension. Furthermore, any metaphor has multiple categories and dimensions of applicability (or multiple meanings). For example, “life is a journey” can mean that life is “short”, “long”, “fun”, “has a beginning, a middle, and an end”, etc. However, no person can establish all the possible meanings of a metaphor at once. And if they did, it would create a huge demand for processing. Once again, what our theoretical proposal offers are dynamic constraints on the meaning of metaphors. Previous theories assumed metaphors as a semantic phenomenon isolated from the rest of cognition. We wish to advance research by articulating metaphors with the rest of cognition, a cognition that is both cultural and individual.

Bowdle and Gentner's (2005) analogical model proposes that the two domains involved in metaphor processing are paired, and then mappings are established privileging deep structures rather than superficial ones. As the authors state: “The problem of property selection is solved because only those common elements that are part of the maximal structurally consistent match will be included in a metaphor's interpretation.” (p. 197). Again, this model is also generic, not contextual. It treats mappings and property selection as a semantic process independent of cultural and individual factors and does not predict differences in meanings that metaphors may have in different contexts or for different people. While traditional theories focus on stabilities, our approach focuses on stabilities and instabilities in processing.

### 4.6 Mechanisms: analogy, categorization, lexical disambiguation, metonymy?

An important question regarding metaphors is whether they are processed by cross-domain mappings (analogy) or within-domain mappings (categorization/metonymy) or by lexical disambiguation. When we think of a metaphor like “my lawyer is a shark”, our first thought is that it is a case of cross-domain mappings, since sharks and lawyers are very different entities, belonging to two different categories: fish and humans. Glucksberg (2008) would argue

that limes and oranges are alike in many ways, which makes them a part of the category of "citrus fruits". But sharks and lawyers are alike in being cruel, predatorial, and mean, which can make them a part of the same category of "cruel entities" as well.

Most things are alike in some respects and different in others. When we see two rabbits, we ignore their individual differences and declare they belong to the same category. Oranges and pineapples look completely different, but they are similar enough to be part of the same categories of fruits and citrus. Alzheimer's disease can be classified as a disease or a good possession, depending on the culture. Categories are not established objectively by item similarities, but also by our own beliefs and ideologies. Just think about what sort of things enter the category of beautiful, good, and worthwhile. You certainly can have categories of things that belong to different domains: a person and a building can both belong to the categories of beautiful and wonderful things.

A park table and a squarish rock that we put our food on top of can both belong to the category of tables, even if the second is a provisory table. A coffin and a table that Sylvia Plath used to write poetry about her deceased father can both be coffins, even if the second is a provisory one. It seems like metaphors and analogies lack some of the defining features of the category of things they are being categorized as or compared to. Plath's table/coffin lacks a real body but has the ideal of the body. The rock/table lacks the human design which makes tables but has the same functionality. The mechanisms of analogy and categorization seem to be the same, that is why drawing the boundaries between them needs to be a case-by-case situation, sometimes it may be an arbitrary call. Lawyers and sharks are closer in their feature of "cruelty" than Sylvia Plath's table and her father's coffin share in the feature of "serving to contain the remains and ideas of her father". That is why the last sounds more analogical than the first, or the first sounds more categorical than the last. Categorization and analogies are in a continuum (HOFSTADTER; SANDER, 2013).

The idea that metaphors are about categorization (GLUCKSBERG, 2008) or metonymy (GIBBS, *in press*) is related to the fact that two entities can be equal in different dimensions, as we have mentioned in this paper. It emphasizes, among other things, the continuity between properties of different domains. Lawyers and sharks are both cruel, and under this trait, they can belong to the same category. This should also be seen in the fact that people who are treated for phobias (e.g., fear of rats) with Behavioral Cognitive Therapy end up not only overcoming their fear but also confronting other unpleasant situations in their lives (e.g., a menacing husband or boss) - i.e., gaining strength to overcome one menacing situation leads to the overcoming of other partially similar situations. It seems like our common-sense knowledge of

categories is not respected by the mind. We do treat (unconsciously) superficially dissimilar things as deeply related and belonging, in a way, to the same category.

There is another interesting issue regarding (attributive) metaphors and similes, which we have mentioned previously. Novel metaphors are said to be generally processed by analogy and conventional metaphors by categorization (GENTNER; BOWDLE, 2008). Novel metaphors are preferred in the simile form, whereas conventional metaphors are preferred in metaphoric form (BOWDLE; GENTNER, 2005). Thus, novel metaphors and similes are believed to be processed by analogy. But some novel metaphors can be processed just as fast as conventional ones. What is more interesting is that "he is a well-paid shark" is processed by making the adjective modify the metaphoric meaning of "shark". In contrast, "he is like a well-paid shark" is processed by modifying the literal meaning of shark, which makes the sentence nonsensical. By these examples, it looks like the real difference between some (but not all) similes and novel metaphors in contrast to conventional metaphors is as follows. In processing similes and novel metaphors, we have to hold the two domains in working memory as separate literal kinds. Processing metaphors automatically may involve analogies, but because you do not have to hold the two entities in working memory, they are faster. Novel metaphors can be this automatic when they are apt. Thus, conscious and unconscious processes, novel and conventional metaphors, similes, and metaphors are not categorical distinctions, they are in a continuum. You can process novel metaphors rather unconsciously and by cross-domain mappings, provided they have shared (culturally) salient attractor (thus, this is not merely a case of aptness, as Glucksberg, proposes, but of sharing salient attractors). **Conscious and unconscious processes don't take place because of the novelty of the metaphor or situation, but by unexpected actions that demand a reorganization or a reorientation of cognition.**

Other noteworthy examples include cases like "addiction to love" which is a real kind of addiction, but different from the prototypes of addiction that involves abuse of an illegal substance or gambling. As we mentioned, these are cases where the two domains are in a continuum, which blurs the boundaries between categorization and analogy, or categorization, literal and metaphoric.

Idioms were famously expected to be stored in our "lexicons" as a lexical entry, much like a dictionary. That is why we can say "He kicked the bucket" (metaphoric) but not "The bucket was kicked by him" (literal). But we know that context can change that. For example: "John died of a terrible disease. What a bucket that man had to kick!" In this context, the metaphoric meaning is likely to be accessed right away (instead of or concomitant with the literal meaning) (cf. GIBBS, 1994). Or yet: "My lawyer is a shark" (metaphoric) and "A shark

was my lawyer" (Literal), but "What a shark that lawyer is!" (metaphoric). It seems like instead of saying that the meaning of a metaphor is associated with its vehicle (GLUCKSBERG, 2008), we would rather assume the meaning is set in relation to an attractor that involves the linguistic expressions and how much it tends to vary in context. Stronger attractors are those that tend to happen in just one type of expression. Thus, what some theories propose is a "lexical entry in a mental dictionary" is an attractor, with multiple information, and is probabilistically accessed depending on how multiple contextual factors interact. Thus, linguistic expression, plus semantic domain, plus familiarity, etc., can all be changed by degrees (i.e., they are continuous rather than categorical distinctions). And these changes show that the pull of attractors can be more or less strong depending on how we vary these dimensions. **Language and cognition are continuous and smooth.**

The last point I would like to address is whether metaphors are analogies. Some authors take the mark of analogy to be a relational one, in which A is to B, such as C is to D. In this sense, some metaphors are analogical (GENTNER, 1988). By other definitions, analogy is any matching between two domains. And again, it might not be a deterministic case to decide if metaphors are analogies, because it is not always clear when we are faced with two separate domains, as discussed by Gibbs (*in press*). In all cases, whatever metaphors are is not to be reduced to one variable, and perhaps not to one mechanism.

## 4.7 Conclusions

One of the difficulties in dealing with language is that one can say they are "addicted to their boyfriend" without exhibiting any neurological changes that would accompany it in other circumstances (and even without ever experiencing those changes). Metaphors do seem to be processed in different ways in different contexts. To deny variation in order to pursue some abstract homogeneity leaves us with an implausible model of language and prevents us from exploring what makes meaning truly humane: its interplays between stabilities and instabilities, between commonalities and particularities. Its adaptability.

Processing metaphors present us with attractors, which are salient senses and properties of metaphors or target and source domains. But typical attractors can be overruled or remain gradiently available given how strong other factors during processing might be. That is why language processing is non-deterministic. Metaphor processing engages continuous processes of categorization and analogy, dynamically self-organizing into unique and varied interpretations.

The advantage of conceiving of these processes in terms of complex systems instead of computations is to have in mind that what looks like computations is an emergent idea from the interactions between our knowledge about computers and the phenomenon we are trying to describe. Nature is more sophisticated and nuanced than computers. By understanding categorization, analogy, schemas, etc. as approximations, but not the phenomenon we study, we are able to integrate multifactorial biases into our models of emergent, self-organized behavior. Every factor studied contributes a partial explanation of what metaphors are and how they are processed. There is no model - even the one presented here - that contemplates all relevant information we will still gather about metaphors. But we hope that understanding metaphor's complexity as dynamic and interactive is a step forward in the right direction

Let us be clear that we are not saying that theories such as Blending Theory (FAUCONNIER; TURNER, 2008), Relevance Theory (SPERBER; WILSON, 2008), and innumerable others have nothing to contribute to our understanding of metaphors. They do. But they are limited too, as all are. Especially so in considering the fact that metaphor processing is dynamic and contextualized. Metaphor processing might involve matching or access to different kinds of properties of source and target domains, and no theory proposed so far can account for all the facets of metaphors.

[Discrete state machines] move by sudden jumps or clicks from one quite definite state to another. These states are sufficiently different for the possibility of confusion between them to be ignored. Strictly speaking there are no such machines. Everything really moves continuously.
Turing, 1950

# 5. Why metaphors are in a continuum

## 5.1 Introduction

As Scientists dealing with extremely complex problems, we are familiar with a reductionism program that is organized around the idea of "divide and conquer". As a result, we create artificial boundaries to phenomena that are best characterized as continuous. The advantage of creating artificial boundaries is that we make problems amenable to study, given our limited capacity to deal with multiple intertwined variables. The disadvantage is that this is very simplistic. For example, we divide the brain into three levels, known as the reptilian brain, the limbic brain, and the neocortex. This division, although very important for scientific research, is inconsistent with the fact that (i) there is considerable anatomical overlap between these layers; (ii) there is an overflow of information throughout all layers; (iii) automatic aspect of behavior that is associated to these layers are not separable; (iv) evolution didn't shape each layer in isolation (SAPOLSKY, 2017). Thus, boundaries are useful for some purposes, but not realistic.

In the cognitive sciences, the mind is often taken to be a computer with discrete states. But as Spivey (2008, p.3) argues, this idea that the mind is discrete is based on our observations of motor outputs, but the mind is actually fuzzy, graded, and probabilistic:

> Each hand usually grasps only one object at a time. Each footstep is usually in only one particular direction at a time, not multiple directions. When you talk, your mouth usually utters only one sound at a time. The external discreteness of these actions and utterances is commonly misinterpreted as evidence for the internal discreteness of the mental representations that led to them. Thus, according to the continuity of mind thesis, the bottleneck that converts fuzzy, graded, probabilistic mental activity into discrete easily labeled units is not the transition from perception to cognition—contra cognitive psychology. Rather, that conversion does not take place until the transition from motor planning to motor execution. Everything up to and including that point is still distributed and probabilistic. (And sometimes even the motor execution still has some multifarious gradations in it as well.)

In linguistics, we often create boundaries between mental phenomena that are continuous (e.g., syntax, semantics, and pragmatics, or abstract concepts and concrete concepts). The boundaries serve us well, up to the point they impair our capacity to understand different facets of the mind. These phenomena are not separate modules. There is overlap between syntax, semantics, and pragmatics (and between mental and bodily phenomena). The objective of this chapter is to explain why and how metaphors are in a continuum.

This chapter is a reply to Raymond Gibbs' question about what is continuity in metaphors.

## 5.2 Dimensions of information

Consider how you process a metaphor. This is a behavior. Behaviors are put in motion by the adjustment of much probabilistic information. Processing a metaphor does not happen en bloc (Gibbs, 2017), it happens by the adjustments of information in multiple dimensions. Some of these are well known in the psycholinguistics literature. For example, the familiarity of a metaphor is related to how often you have been exposed to a given metaphor[16]. We collect information on participants' familiarity with metaphors by asking them how familiar the metaphor is in their opinion. This is measured, for example, in a 5 points scale that ranges from "very unfamiliar" to "very familiar".

A metaphor like "life is a journey" is probably more familiar to you than "women are bacon". And the more familiar a metaphor, the faster you will process it. Familiarity is continuous since we can always come up with metaphors that feel more or less familiar. For example, "Mary is an Alaska" might feel more familiar than "women are bacon" since it is an extension of "Mary is cold", which is probably more familiar than all the previous metaphors. It is important to have in mind that familiarity is derived from the experience of each individual since how often anyone is exposed to a metaphor may change. A metaphor like "theories are buildings" is very familiar to adult scholars, but less so to children and less educated members of society.

Familiarity is continuous for another reason as well. And this is key to understanding continuity. **Continuity exists because cognitive phenomena are not categorical, modular, a fixed bloc, or symbolic.** Every phenomenon is built up from a juxtaposition of many

[16] Sheer repetition of information does not equate to familiarity with it. Repetition is important, but there are certainly different processes that happen with repetition (e.g., the interplay between variation and stabilities in the co-occurrence of contextual information, meta-cognitive processes, familiarity with the terms of the metaphor, etc). Thus, familiarity is a coarse-grain measure of intricate processes in which repetition plays an important role.

dimensions of information. For example, familiarity is not a “thing”, it could be decomposed into many intertwined factors. And that is the difficulty of dealing with cognition, you can certainly decompose phenomena (at least approximately), but you cannot disentangle them completely. We mentioned that familiarity is related to how frequently a person is exposed to a metaphor. But the sheer repetition of information does not equate to familiarity with it. Repetition is important, but there are certainly different processes that happen with repetition (e.g., the interplay between variation and stabilities in the co-occurrence of contextual information, meta-cognitive processes, familiarity with the terms of the metaphor, etc). Thus, familiarity is a coarse-grain measure of intricate processes in which repetition plays an important role. It is continuous not only because the frequency is continuous, but also because the juxtaposition of the dimension of information is continuous (since each phenomenon is a combination of phenomena).

There are other types of information we measure with the same type of scales, for example, the aptness of a metaphor. Aptness is related to the degree to which a metaphor vehicle captures important features of the topic. A metaphor like “life is a journey” is likely to be more apt than, again, “women are bacon”, since this one is a bit strange and harder to process. The conventionality of a metaphor (in my definition) is a measure of how much a metaphor is part of culture regardless of how familiar it feels to you. This might cover metaphors that are used by people in other generations or groups (e.g., experts) that you do not necessarily understand very well, but you know they are used. Of course, familiarity, aptness, and conventionality of information may greatly overlap within metaphors, but it is possible (even if hard) to study their effect in quasi-separation (DAMERALL; KELLOGG, 2016).

Moreover, Bowdle and Gentner’s (BOWDLE; GENTNER, 2005) theory “the career of metaphors” proposes that novel metaphors are processed by analogy and conventional metaphors are processed by categorization. One problem with the theory is that novel and conventional metaphors are not completely distinct entities, they are in a continuum, as we discuss here. In any case, if you ask most scholars to explain why metaphors are in a continuum, they will probably refer to the continuum that goes from novel metaphors to very conventional ones (even to dead metaphors). As an approximation to the object, this continuum makes sense. But there is more detail to unravel. For example, it is well known that some novel metaphors can be processed just as fast as conventional metaphors (GLUCKSBERG, 2008). Bowdle and Gentner’s theory cannot account for that. In this thesis, we suggest a different account for metaphors that explains this phenomenon. The point is, always, there is no clear-cut phenomenon, just continuity.

The point we want to make is that any metaphor is processed by a mosaic of information. Not only are they processed like this, but whatever we call “representation” is a set of more or less reinforced patterns of information. Representations are not static symbols.

## 5.3 Continuum of information

Representations are fragmentary. They must be fragmentary to allow for gradience or to access it partially, instead of whole blocks. Besides, representations must interact with sensorimotor apparatus and information in a way that rigid symbols seem not to be able. The apparatus for representation processing must be complex enough to interact with motor constraints (GARCÍA; IBÁÑEZ, 2016). Take perception as an example. Hubel and Wiesel (HUBEL, 1988) have shown that there are subroutines in the brain for judging orientation in line segments. The neural clusters that make the subroutines are organized in levels. Goertzel (GOERTZEL, 1994, p.27) explains that

> At the lowest level, in the retina, gradients are enhanced and spots are extracted -- simple mechanical processes. Next come simple moving edge detectors. The next level up, the second level up from the retina, extracts more sophisticated information from the first level up from the retina -- and so on. Admittedly, little is known about the processes two or more levels above the retina. It is clear, however, that there is a very prominent hierarchical structure, although it may be supplemented by more complex forms of parallel information processing (Ruse and Dubose, 1985). To be extremely rough about it, one might suppose that level 1 corresponds to lines. Then level 2 might correspond to simple geometrical shapes, level 3 might correspond to complex geometrical shapes, level 4 might correspond to simple recognizable objects or parts of recognizable objects, level 5 might correspond to complex recognizable objects, and level 6 might correspond to whole scenes. To say that level 4 processes recognize patterns in the output of level 3 processes is to say that simple recognizable objects are constructed out of complex geometrical shapes, rather than directly out of lines or simple geometrical shapes. Each level 4 process is the parent, the controller, of those level 3 nodes that correspond to those complex geometrical shapes which make up the simple object which it represents.

The point of this hierarchical (possibly heterarchical) model is to deal with patterns of information gradiently. Of course, there is much more which needs to be orchestrated and explained about how the mind processes information, but this should be the part of the puzzle that allows us to deal with information in fragmentary ways.

Each metaphor is a bundle of co-occurring (old) information plus its interactions with contextual (novel) information. As such, there are many types of information that compose metaphors, and they must not be present on every processing occasion. Sensorimotor information is one type of information and can probably be broken down into aspects of real

experience instead of being some fixed structure (e.g., experiencing warmth may facilitate the processing of "she is a warm person"). Then, there is gestalt/schematic information, which is the overarching connections between scripts and frames (e.g., we know that both discussions and wars have a beginning, a middle, and an end and that it involves strategizing, fighting, and winning or losing). There is attributive information (e.g., knowing that both lawyers and sharks are cruel), perceptual information (e.g., both teeth and piano keys are white and rectangular-ish), etc.

The concepts used in metaphors also have their own bundle or profile of information. "Life is a Journey" consists of two relatively more abstract concepts ("Life" being yet more abstract than "journey", since it encompasses more types of experiences) than "Teeth are piano keys". Metaphors can also vary in how stable their linguistic expressions are. For example, the idiom "She gave me an ice" ("Ela me deu um gelo") is made up of a more stable linguistic expression than its metaphoric counterpart "she was cold to me" ("Ela foi fria comigo"). The prediction is that altering language in the first case would make for a harder to read metaphor than the alteration of the second metaphor, even though they use the exact same concept (i.e., "She gave me an Alaska" should be harder to recognize and process than "She was an Alaska to me"[17]).

Moreover, metaphors like "she is cold" and "she is an Alaska" do not merely differ in the concepts they have, but also in other (continuous) dimensions, like the fact that one is more conventional than the other, one is more hyperbolic than the other, one is potentially more evocative of more properties than the other (e.g., Alaska is big, populated, a country, has boundaries, etc). The compound effects of these variables are not fully acknowledged or understood. For example, Thibodeau and Durgin's (2008) experiment shows that conceptual metaphors are processed by cross-domain mappings when (some) conventional and novel conceptual metaphors are followed by novel conceptual metaphors. However, as we all know, there are no minimal pairs when it comes to psycholinguistics. The differences between conditions are greater than the conventionality of metaphors. For example, one variable that seems to affect the representation of concepts is their collocation in discourse and texts: "tell me your company and I'll tell you what you are". That is because we learn the meaning of words also from linguistic contexts. By using LSA[18] to measure the distance between just the last different word between conditions in Thibodeau and Durgin experiments, we can tell how

[17] In an experiment we present in this thesis, most participants identified that "Mary is an Alaska" means that "Mary is cold".
[18] http://lsa.colorado.edu/, accessed on nov, 2021.

semantics alone predicts the difference between conceptual metaphors and the literal condition. The table below shows the word “repair”, which is a target word within a sentence that finishes the different texts used in different conditions in the experiment. The words “milling”, “grinding”, “solving”, and “fix” are part of the different conditions, namely, novel, conventional, non-metaphoric, and literal. We can see that the word chosen for conceptual metaphors is the closest to the target words (repair). Thus, it should predict a faster reaction to conceptual metaphors. Except that novel metaphors seem to need further processing to compensate for their relative semantic distance (when reading the target word). Thus, we get no significant difference between novel, conventional, and literal conditions. One possible alternative interpretation for this experiment is that literal language processing is always faster. Conventional metaphors should take longer to process, but, in this experiment, the fact that semantic distance gives conceptual metaphors an advantage, they processed faster than if we had a condition in which the very same words were used in literal and metaphoric conditions. Novel metaphor should be faster (at the target word) due to it taking longer to process when its metaphors first appear. The non-metaphoric condition always takes more time because its semantic distance is greater (sometimes it gets negative distance, meaning this condition does get further apart).

Moreover, other factors may affect this (and other experiments). For example, novel metaphors seem to be more hyperbolic and/or deliberate than conventional metaphors. And as Thibodeau and Durgin discuss in their paper, there are textual factors that may facilitate or hinder metaphor processing.

Table 1: Using LSA to estimate the semantic distance between words used in different conditions in Thibodeau and Durgin’s experiment.

| Condition | Texts | **Repair** |
|---|---|---|
| novel | milling | 0.17 |
| conventional | grinding | 0.25 |
| non-metaphoric | solving | 0.09 |
| literal | Fix | 0.12 |

Besides, metaphors are not all the same. What we call “conceptual metaphors” may have mixed profiles. We can have metaphors that are composed more of one type of information than other types of information. Or that are attracted to some kinds of information more than other kinds. For example, what we usually call “attributive metaphors” (e.g., my lawyer is a shark) is attracted to attributes (e.g., cruel), more so than other information. What we call “conceptual metaphors” is a mixed group, with metaphors like “my mind is a computer” being more similar to attributive metaphors (e.g., “it is fast”), depending on the context, than other metaphors, like “this theory is a building” that behaves more like we would expect from conceptual metaphors. That is, it is attracted to other conceptual information, such as “this theory is solid, has structure, etc.”. In chapter 8 we present an experiment that showcases how this information is distributed in metaphors.

If one asks what a conceptual metaphor is, the answer is: it depends on the context. If one asks what Conceptual Metaphor Theory is about, the answer may be (of course different scholars may make different claims): it is about the embodied and schematic information that is part of generative - or systematically related, or productive - metaphors.

Lastly, we discuss elsewhere the continuity between literal and metaphoric language, which confers the “metaphoricity” of a metaphor. Literal and metaphoric language is not separated by fixed and rigid boundaries. These boundaries do not exist in the mind. We can say that “This is a book” (pointing at a book) is a lot more literal than “Life is a book”. However, there are many cases that fall within categories. “Love is addiction” is literal in the sense that love realizes the same neurotransmitters that are associated with addiction and have addictive properties, making lovers behave like and actually struggle with addiction. But it lacks some other features that are present in our more prototypical concept of (drug) addiction - which are the long-term damages that disrupt the body and the social condemnation (but the last one is also absent from other types of addiction, like sugar addiction). Love also literally creates behaviors like OCD and other psychiatric symptoms. Thus, we could say that love is literally a disease and drives people crazy. But it lacks, again, the social condemnation (which used to exist centuries ago, since single women that were seduced by men could actually be sent to a mental institution).

## 5.4 Metaphoric mappings crawling through timescales

Another way in which metaphors are in a continuum is with categorization, as we discuss in this section.

### *5.4.1 The metaphor and categorization continuum: when two domains are not so different*

Analogy and categorization are on a continuum (HOFSTADTER; SANDER, 2013). Moreover, categorizing is dynamic. Spivey (2007) makes the following point: when we see a cat on the street, our minds do not go from blank to cat recognition. It smoothly follows a trajectory within partially overlapping attractor basins. This would look something like this description: "I see an animal. It is a dog. No, probably a cat or a raccoon. It is a cat." This is a coarse-grained characterization of the phenomenon, but it is enough to highlight that categorization is not a process of all or nothing and it is not static. The point in which a process stops being a categorization and starts being an analogy may be blurred, for the very notion of "discrete separate domains of knowledge" is problematic (Gibbs, *in press*).

Moreover, this continuum may crawl from ancient times (as we mentioned synchronic and diachronic forces contribute to the self-organization of the mind). The idea that metaphoric mappings crawl instead of fly over two domains was proposed by Gibbs (*in press*), which sees metaphors as metonymies (mappings within the same domain). This is not to say that we cannot hold two ideas in contrast and figure out how they are alike (e.g., Socrates helps students to produce their ideas just like a midwife helps a mother to produce her child, that is why "Socrate is a midwife"), but even them, metaphors is what happens in a deeper level, not at the level which we judge Socrates and a midwife to belong to very distinct domains. And it is important to realize that this deeper level needs not look anything like two well-defined nodules that match. Looking from a closer vantage point, why is externalizing an idea a good match to externalizing a baby? The explanation does not lie in choosing Structure Matching Theory (GENTNER, 1988) over Conceptual Metaphor Theory (LAKOFF; JOHNSON, 1980), but in realizing that many mappings contribute probabilistically to how we process metaphors.

The mappings between bringing ideas into the world and bringing a child into the world do not pop up in our minds out of the blue. They are motivated by other forces that crawl in time, like the fact that we tend to conceptualize ideas as children in our culture. In this sense, conceptual metaphors are biases that contribute probabilistically to motivating other metaphors (GIBBS, 2017). After all, we have been exposed to similar metaphors such as: "This is my

baby/my creation (referring to a project or an idea)", "my mind is pregnant with ideas", "this project/idea was born in 1988", "I have conceived of a new idea", "he is the father of that invention" etc. Explaining why we have started to conceptualize ideas as babies involves other probabilistic mappings that also crawl into time (which we can only speculate about): feeling proud of ideas and babies, being overcareful and worried about projects and babies, etc. all of these experiences overlap more than the idea of "separate domains" will have.

But metaphors may crawl from many ancient times. Back in the forest animals categorize predators as a threat regardless of how they look (i.e., lions and crocodiles can eat you, you know that even if you do not speak a language to name it). When humans started to organize into more sophisticated societies and cultures, people that may put you in danger (a thief that can kill you, or a boss that can publicly shame you) became the same sort of beings that, in the jungle, could have prayed on you. It does not matter that your boss is not going to actually eat you, what matters is that you feel powerless in confronting him, that his actions could have strong consequences in your life (e.g., losing a job/reputation). This is enough to make your body give the same type of stress response that zebras give to lions in the jungle (Sapolsky, 1994). The workplace (and the city) can most certainly be a life-threatening jungle, even if by some degree of embodied motivation that cuts across millions of years.

Our need for warmth and affection seems to be a very popular demand in the mammalian world as well. In the 1950s, Harry Harlow's (HARLOW, 1958) famous experiment showed that monkeys that were brought up with surrogate mothers (made either of wire and or cloth), preferred to spend time around the cloth mother, instead of the mother which fed them. Monkeys that were prevented from spending time with the cloth mother presented higher rates of neuroticism. This research helped improve our understanding that newborns need to be held close by adults to develop well. And it is this type of closeness and warmth/affection - mediated by "softness" - that is one of the factors that will later contribute to our metaphorical understanding of affection as warmth (GRADY, 1997). Throughout life, we keep on having different experiences that strengthen the connection between warmth and affection, like the phenomenological feeling of warmth that accompanies our liking of an affective person (SIMAN et al., *in press*).

The only way non-linguistic animals have to resolve their differences is by engaging in a physical fight with other animals. But we developed language and can restrain our impulses to rip our fellow animals apart while engaging in verbal fights and wars. Wars do have cultural

schemas as well, in which we strategize before the fight and use weapons. Yet, a verbal war still shares many roots with our ancestral and fiercer full-body engagements.

When monkeys get sad or stressed about their relationships with other higher-ranked peers, they too drop their shoulders in a submissive and protective position. SADNESS seems to be DOWN for them, even if they cannot write poems about it. In humans, we see how sadness is associated with down in experiments that ask participants to tell a story of their lives as they move objects up or down. Moving objects down leads to more sad stories, whereas moving them up leads to more happy stories (CASASANTO; DIJKSTRA, 2010).

Being social is yet another evolutive advantage for us. Research shows that being excluded from playing a game triggers circuits in the brain related to pain (BERNSTEIN; CLAYPOOL, 2012), that is, we can feel "non-physical" yet real pain from isolation. Yet another example is that the moral disgust that we feel for a politician also recruits the same areas of the brain involved in the disgust we feel for rotten food (SAPOLSKY, 2017). Falling in love can also trigger the same type of neurotransmitter responses we have during addiction, explaining, thus, how love can be addictive (BURKETT; YOUNG, 2012; FISHER, Helen E., 2014). And the sickness we feel in romantic relationships is not merely a cultural idea spread through literature; it is embodied in the sense that we release cortisol, a stress hormone typical of our flight-and-fight responses that helps us survive a predator. Is lovesickness a matter of categorization or metaphor? See the story below:

> Not only did I feel sad and lost and confused and weepy, I also felt physically ill. I remember sitting in a brightly lit diner with my best friend, a few days after my breakup, staring at my plate of food unable to eat. The smell of food, even the idea of it, was completely off-putting. I am not someone who ever misses a meal, but here I was feeling sick to my stomach like I had gastric flu. I thought we just *talked* about being lovesick: I didn't think I was literally going to rush to the bathroom to throw up[19]

Our metaphoric biases and our propensity to create analogies that just slightly deviate from categorization organize much of our behaviors. The field of proxemics studies the interpersonal distance people adopt without ever being explicitly told that this is how they

[19] Available at: https://psyche.co/guides/how-to-ease-the-pain-of-grief-following-a-romantic-breakup, accessed on sept., 2021.

should behave socially. Humans have the propensity to respect different implicit notions of distance that vary from inches when two people are intimate (like lovers or parents and children) to many feet when they don't know each other and are sharing a public space. This type of implicit social knowledge is captured by the primary metaphor INTIMACY IS CLOSENESS.

All of these examples show that metaphors rather than being a cross-domain mapping that flies over very distinct types of experiences, in fact, crawl from partially overlapping experiences. As we focus on biological factors that affect processing, cultural factors should not be disregarded in how we create, extend, and interpret these metaphors.

All these metaphors are probabilistic and some of them can be found by manipulating variables in experiments. But none of them need to be deterministic. In an experiment, we asked participants to describe the analogy behind different metaphors. Even though metaphors of the type MORE IS UP tend to be traced back to the co-occurrence of experience with getting more substance and seeing their level go up, a participant in my experiment suggested that the motivation for "The price of the meat is high" is a different one. He stated that when a product is high on the shelf, we try to reach it but cannot grab it. In the same way, when the price of something is high, we cannot buy it. This would be a relational metaphor that, even if not frequently used, may support interpretation. In fact, that is precisely the nature of cognition: one that is not deterministic and that allows for different behavior to be self-organized contextually.

It is important to notice that not only primary metaphors and conceptual metaphors are in a continuum with categorization. Other analogies are, too. Tranquillo (2019, p. 18) points out that:

> There is a fuzzy line between isomorphisms and analogies. For example, in Douglas Hofstadter's Godel, Escher, Bach, he repeatedly makes connections between how anthills and human minds work. It is not entirely clear if Hofstadter is using the anthill as an analogy for explanatory purposes or is in fact claiming that anthills and brains operate using the same structures, flows, and functions. This will mirror many of the connections made through this text. It will not always be clear if a connection between two systems is an analogy or an isomorphism. For example, when traffic flow is compared to flows in the economy, it will not be clear if this is a helpful analogy or if both systems operate upon the same general principles. It is perhaps safest to assume any system comparison is an analogy that might point to some deeper principle that deserves further exploration.

And in our daily lives these examples might suffice when, for example, we are trying to decide if Jair Bolsonaro's government is literally or metaphorically a case of necropolitics (as pointed out by professor Solange Vereza in a talk).

### *5.4.2 The analogy and categorization continuum: when one experience represents a type*

A different way to see the metaphor and categorization continuum is when metaphors refer to a general type of event. For example, in the film Midsommar (2019), the character named Mark was meant to be recognized as "that type of tourist who does not respect the local's traditions and only wants to have sex with the ladies". Josh was "that kind of scholar that only thinks of his own interests, disregarding his subjects". These categorizations that are not conventionalized around a proper name (e.g., dogs, cats, love, etc.) are used in our everyday lives when we categorize people as "that kind of people who does so and so", "I know what kind of person you are", etc.

Very often situations prompt us to recognize them as some type of metaphoric activity. For example, in the Tv series Sex and the City, the main character would always trip on the floor, which was meant to allude to her life, in the sense that she always messes it up. In Suicide Squad 2, Robert DuBois is diligently scraping a piece of gum off the floor, which is meant as a cue to how he does not give up on difficult tasks in his life (which plays out at the end of the movie, when he decides to fight the villain even though he did not have to). These metaphorical mapping between concrete actions and life are meant to be closely related even though our semantics of domains might suggest otherwise.

Gibbs (*in press*) discusses the following scenario:

> Imagine the following situation. You are driving home after work and unexpectedly have to go around a big loop, due to a new highway construction project. This delay getting home makes you think about how this obstacle is representative of many other aspects of your life. You often encounter obstacles in many facets of day-to-day living.

The author asks whether we are engaging in cross-domain mappings or categorizations in this case. Regardless, the relationship between facing real obstacles and facing metaphorical obstacles is more congruent than incongruent, if we look at how much both experiences share: they are both frustrating, make you waste your time, prevent you from getting what you want, etc. They are only distinct when we focus on the outermost layers of both experiences.

Metaphors only look like they are flying across domains when we think that, for example, a person leading a life is being compared to a traveler. She is not. On a more abstract level, they are both agents experiencing congruent feelings and consequences.

But metaphor can engage more superficial levels of knowledge. That is the case, for example, in the following pun: “This work is as fruitless as a butchery”, which invites the property of actual fruits. In contrast, most conventional situations might involve a different level of analysis, which gives people the impression that some metaphors are alive and others dead (Steen, 2017). However, these levels are continuous (even if they present some strong attractors).

## 5.5 Conclusions

In this chapter, we explored some of the aspects of metaphors that put them in a continuum. We discussed classic measures that affect metaphor processing, like familiarity, metaphoricity, aptness, and conventionality. These measures are continuous because they are not an object in the mind, they are approximations for composed phenomena. For example, familiarity is probably not a measure of sheer frequency of exposition to the metaphor, but also of metacognitive processes and the interplay between similar and different contexts (linguistic or otherwise).

We have also considered how metaphors are composed of different types of information, from schemas to attributes, that grant metaphors different profiles. The variation in types of information also put them in continuous, rather than categorical distinctions. For example, “conceptual metaphors” are metaphors that share, first and foremost, the property of being “systematic” (that is what all have in common). But rather than this making them a separate group, the same metaphors also have attributive properties (among other properties) that make some of them more or less close to prototypical attributive metaphors (which may share traits with other facets of metaphors or cognition). All of this goes to show that cognition is intertwined. Possibly because processes used for one phenomenon may affect other phenomena (i.e., nothing is independent in the mind).

Lastly, we have also pointed out how metaphors are in a continuum with literal language and with categorization. In this chapter, we hope to have helped make the case that metaphors are in a continuum for a variety of reasons, but importantly, because continuity is pervasive in

cognition, rather than modularity. We hope that the same line of reason can be applied to all cognitive phenomena, from syntax to life itself (DI PAOLO et al., 2018).

> The challenge now is for CMT scholars, and others, to create more dynamical explanations of how people in real-time use and understand verbal metaphors in complex discourse situations. At the very least, we need to begin describing the interacting constraints that give rise to metaphorical language and interpretation rather than simply, and endlessly, arguing about whether conceptual metaphors are, or are not, recruited in verbal metaphor use.
> Gibbs, 2017

> A well-organized society is one in which we know the truth about ourselves collectively, not one in which we tell pleasant lies about ourselves.
> Tony Judt

# 6. On Conceptual and Deliberate Metaphor

## 6.1 Introduction

Conceptual Metaphor Theory (CMT), famously introduced in *Metaphors We Live By*, by Lakoff and Johnson (LAKOFF; JOHNSON, 1980), is an important theory because it changed the locus of metaphors from language (i.e., linguistic expressions, utterances) to the mind (i.e., cognition, concepts). From this perspective, metaphors are not only "linguistic deviations" used for poetic and rhetorical purposes; metaphors are a part of our day-to-day most trivial conversations, scientific discourse, and cultural imagination: metaphors are ubiquitous. For a long time in linguistics and cognitive sciences, the metaphors we use in our daily lives were considered to be "dead" (i.e., like literal language). CMT argued that our understanding of metaphors was, in fact, dead wrong - metaphor is vital to our conceptualizations of the world.

As important as CMT is, some of its proposals were questioned by years of arguments and empirical evidence (GLUCKSBERG; BROWN; MCGLONE, 1993; GLUCKSBERG; MCGLONE, 1999; MCGLONE, 2007, 1996). Currently, there are new theories that are meant to solve CMT problems and move our understanding of Conceptual Metaphors forward (GIBBS, 2019; KÖVECSES, 2017; STEEN, 2017). But the fact is, nobody knows what a Conceptual Metaphor is.

Here is a brief characterization of some current proposals of what conceptual metaphors might be (in the following sections we will cover Lakoff's proposals in more depth). For Lakoff and Johnson (1980), conceptual metaphors are cross-domain mappings stored in semantic memory that are activated every time we process a conceptual metaphor, like: "This relationship is not going anywhere", "I'll go down with this ship", etc. The theory is also meant to explain why many metaphors are systematically related. For Kövecses (KÖVECSES, 2017, 2019),

conceptual metaphors should be decomposed into schemas, frames, and domains that are stored in our semantic memory. In every context (thus "dynamically"), metaphors are processed by the articulation of these multiple sources of knowledge. Thus, processing metaphors can vary in granularity (i.e., one might activate only some vague scheme of knowledge or activate a full source domain). For Gibbs (2019), conceptual metaphors are self-assembled in use, from embodied, environmental, and other constraints. Gibbs' perspective on metaphors is non-representational, which means that schemas, domains, and other classic constructs of Cognitive Linguistics are not a big part of his theorizing (even though it is not absent from it).

But after all, what is a conceptual metaphor? If we are going to start a war (GIBBS, 2017) for or against Conceptual Metaphor Theory (LAKOFF; JOHNSON, 1980), I would suppose we know how to answer this question. Since we are here, what is a metaphor and how is it different from literal language, in case it is different? In science, we fight a lot for unfathomable causes. One of the latest disputes is over conceptual and deliberate metaphors (GIBBS, 2017; GIBBS, 2011, 2015; GIBBS; CHEN, 2017; STEEN, 2017).

The controversy over Conceptual and Deliberate Metaphor Theories is mainly centered around the issue of when a metaphor is processed by cross-domain mappings. Steen (2008) has proposed that only deliberate metaphors are processed by cross-domain mappings, thus, they are the only real metaphors. Non-deliberate metaphors would exhibit a different mode of processing, for example, lexical disambiguation. This is a big blow over Conceptual Metaphor Theory's important claim that the conventional metaphors we thought were dead are, in fact, alive, and are processed by a system of cross-domain mappings. Are we regressing to a state of knowledge in which we deny the role metaphors play in our unconscious processes (GIBBS; CHEN, 2017)? Or are we giving a step forward into a more nuanced understanding of metaphors (STEEN, 2017)?

The answer depends on our understanding of both theories. In science, we rarely get to have definitive answers to questions, but we get to have answers that are more consistent with empirical results, more logical, more useful, less contradictory, etc. The goal of this chapter is to clarify some of the issues concerning Conceptual Metaphor Theory (CMT) and Deliberate Metaphor Theory (DMT). We understand that reaching a middle ground in these disputes is a good opportunity for theoretical development in our field.

## 6.2 Why we fight over metaphors

To understand why we fight over metaphors, we need to understand why we fight over everything in the cognitive sciences. As we all know, experiments' findings are full of contradictions. We may sometimes find support for a theory, but at other times do not. We do not want to ignore the findings that challenge our theories. At the same time, we do not want to abandon the theory at the first failed attempt to find support for it. How do we make sense of the landscape of empirical findings? Let's consider some of the ways scientists think about experiments' results.

### *6.2.1 The "absolute" rationale*

The "absolute" rationale is typical of the early studies in Psychology, in which the underlying assumption was that there was only one processing mechanism responsible for what scholars suppose is a cohesive phenomenon (e.g., metaphor, grammar, etc.) and that there is one test (i.e., possibly an online test using the most precise technology available) that could rule out competing explanations (i.e., theories, "inferior types of experiments", etc.). Because some scholars believe in the existence of one ideal test that will rule out the psychological plausibility of theories in competing programs, they will always come up with different further standards of testing. For instance, they might want to claim that only a positive result in "online tests[20]" really matters to corroborate a theory (rejecting the results of off-line experiments) (FERREIRA; YANG, 2019). And if one finds evidence in online tests, they can further question if this evidence is too early in processing, which could be argued against some theory's claims. For example, for a theory of meaning, if the investigated effect happens too early in processing, it might be argued that the activated meaning is not a part of the final construction of meaning, or if the effect is too late in processing, scholars might wonder if the finding is an epiphenomenon. This is, of course, how we do science: we question every result, which prompts us to create other tests that will rise to the challenges.

On the other hand, this rationale has problems. For instance, there is no reason to downplay results from off-line experiments because off-line and online tests might be assessing

[20] "Online tests" measure the time people take to respond to a stimulus. It used to be considered a "superior" test in comparison with off-line tests (which do not measure time), because in off-line tests participants could possibly engage in different strategies that would disguise their "true behavior". But this is not how scholars think about the difference between online and off-line tests anymore.

different facets of processing (i.e., what people do when they are processing language fast, e.g., skimming through a paper; and what they do when they have more time to think about it, e.g., reading a poem). Moreover, online tests can have problems, for example, sometimes scholars might not know if participants are reading the texts with enough depth to interpret them, especially when the questions that are meant to check people's interpretation of sentences are placed after fillers, to not contaminate the actual stimuli (FERREIRA; YANG, 2019).

Even when theories pass many empirical tests, but only under some conditions, scholars are still skeptical about the tested theory, mostly, because they expect theories to be normative and valid in absolute terms. That is, they theorize about the mind as if the phenomena investigated were generic, equal for everyone, and in every context.

We understand that science needs to generalize if it is meant at predicting something, even at the cost of realistic descriptions. As Smaldino (SMALDINO, 2017, p.316) puts it: "The articulation of the parts of a system and the relationships between them always involves incurring some violence upon reality. Science is an iterative process, and pragmatically, we must ignore some details about complexity and organization to make any headway." But prediction and explanation can be two different things entirely.

For example, McElreath and Smaldino (MCELREATH; SMALDINO, 2015) proposed a model to solve challenges discussed by the Open Science community (e.g., should journals publish negative results? Should we replicate all findings? etc.). By adopting a simple model that ignores most of the complexity in the world, the authors managed to figure out that regardless of how much replication is done, the biggest impediments to the effectiveness of science are: (i) low base rate (i.e., the a priori probability that a novel hypothesis is true) and (ii) high false-positive rate (i.e., a result that indicates that the hypothesis is true when in fact it is not). This is not meant to be a final answer to our scientific problems, since models can be questioned and improved upon, but it is a good way to make a complex problem tractable, which is what scientific theories do. In this case, the authors know that they are ignoring many important aspects of reality, as Smaldino (2017, p.328) states about his model: "It ignores researcher bias, multiple testing, and data snooping. It ignores the incentives that drive scientists in choosing and publishing results, as well as differences in exclusivity and impact between journals", so they are not explaining reality, but simplifying it to make a prediction or to devise a plan of action.

As theories in cognitive science try to explain a phenomenon, they tend to ignore everything that might be messy, individual, and contextual. Of course, the advantage of proposing generic theories is aiming for generic tests and predictions that might hold at least often enough - for science, prediction is one of the most important aspects of theories (LAKATOS, 1978). Conceptual Metaphor Theory, at its conception, was part of the "absolute" tradition. Lakoff's (1993) claim that conceptual metaphors are processed automatically and unconsciously by cross-domain mappings was a general claim (even if the author himself knows that this might not be true, his theoretical claims have no nuance and his theory is disputed as one candidate to the position of THE one and only theory of metaphors, since no pluralistic model was ever endorsed in his tradition). That is, the theory offers no specification about the conditions when its proposals should apply or not, i.e., there is no theorizing about what happens when Conceptual Metaphors are not accessed. The theory is treated by many as plausible enough to account for reality. This creates all sorts of problems: (i) we ignore the evidence that contradicts the theory; (ii) we apply the theory to problems that are beyond its explanatory capacity (because we think about the theory in absolute terms) (e.g., LAKOFF, 2014); and (iii) we sweep under the rug the complexity and heterogeneity of the mind.

On the other hand, there is also a positive side to this rationale or position: scholars need to stick to a theory and develop it to its limits because there is a level of uncertainty in the psycholinguistic and the scientific literature (e.g., ideas come and go, then come back later in a more nuanced position). As we have learned from other sciences, there is nothing wrong with working with Newton's theory even if it was born refuted. However, no progress can be made if we do not start dealing with the limits of our scientific theories.

### *6.2.2 The conditional-absolute rationale*

Classic scientists like universal rules, not pluralistic explanations. Here is an example of what Pinker (PINKER, 2009, p. 282) says about having to evoke a mixed explanation for experiments' results, instead of finding some underlying rule:

> Tarr and I glumly wrote up a paper begging the reader to believe that people use a different strategy to recognize mirror images. (In psychology, invoking "strategies" to explain funny data is the last refuge of the clueless.) But just as we were touching up the final draft for publication, an idea hit [...].

It is always possible that what looks like different phenomena is actually the same phenomenon. However, sometimes different is different and we must deal with it.

It has been a while since metaphor scholars advocated for some form of pluralistic view of metaphors, one in which we acknowledge more than one way of processing metaphors (BORTFELD; MCGLONE, 2001; BOWDLE; GENTNER, 2005; STEEN, 2008). Thus, the task we face is to specify under what conditions metaphors are processed one way or another. For example, for Bowdle and Gentner (2005), novel metaphors are processed by cross-domain mappings (or analogies), whereas conventional metaphors are processed by categorization. For Steen (2017), deliberate metaphors are processed by cross-domain mappings, whereas non-deliberate ones are not. This is a matter of stipulating some abstract and general conditions, for example: one can defend that Conceptual Metaphors are part of the meaning ONLY when [select a clear-cut level of analysis]. In this perspective, there is a reductive and binary reasoning style in which we try to specify generic conditions for metaphors to be processed in some way versus some other way.

This is still an approach based on reductionist thinking, or on the idea that we can divide cognition into perfect parts and exact rules. On a positive note, the compromise between theories seems like a bold statement that is not always welcome in classic cognitive science.

### *6.2.3 The conditional rationale*

Psychology seems to be realizing that most of the effects we study are not pervasive, that is, they are subjected to conditions (BARSALOU, 2020) and some of them are not universal, that is, some people may present them while others may not. While it is common to ignore individual differences in group studies, we should be more careful with what cognitive effects we deem "universal". For example, a recent study shows that the minority of participants (less than 45%) exhibit the Spatial–Numerical Association of Response Codes (SNARC) effect, which is an effect related to the association of numeric concepts to left-to-right coordinate of space (or a "mental line of numbers") (CIPORA *et al.*, 2019; SIMAN; FIGUEIREDO, 2021). Thus, while the SNARC effect is a very robust phenomenon (i.e., you will probably find it every time you run an experiment), it is not a universal phenomenon.

The discussion on whether sensorimotor information is active (or if it is a part of the meaning of words, sentences, and discourse) used to be framed in absolute terms: is

sensorimotor information a part of the meaning: yes, or no? If you picked the "no" side of the debate, together with traditional scientists who think the mind is a computer, you would have to face every positive result that corroborates the sensorimotor grounding of meaning with a further question. Is this effect too soon in processing, therefore not part of the final meaning? Is it too late in processing, therefore an epiphenomenon? If you picked the "yes" side of the debate, you would have to explain away whatever data did not show that sensorimotor areas of the brain were active.

But the issue was soon shown to be more complex than the polarized discussions. There is plenty of evidence that sensorimotor systems are active during language processing, even if not always. The evidence covers the activation of somatotopic regions of the brain when processing action related-words, for instance, feet-related action words, such as "kick", should activate feet-related areas in the brain, instead of hand-related areas (GARCÍA; IBÁÑEZ, 2016; PULVERMÜLLER, 2005, 2018; PULVERMÜLLER; FADIGA, 2010). The same type of co-activation with language is true in other sensorial systems, such as the primary olfactory cortex when processing the word "cinnamon" (GONZÁLEZ *et al.*, 2006), the secondary gustatory cortices when processing "salt" (BARRÓS-LOSCERTALES *et al.*, 2012), etc.

In short, studies show evidence that sensorimotor systems are recruited for processing words in all modalities (gustatory, auditory, visual, olfactory, sensorimotor). Moreover, there is support for the claim that the activation of sensorimotor systems is not an epiphenomenon since these systems are active at the early stages of language processing (KIEFER *et al.*, 2008, 2011). This is not to say that sensorimotor systems need to be recruited at all times: there are contextual variations even for the so-called "essential features" of any concept (BARSALOU, 2016). This also does not mean that sensorimotor systems are indispensable, or that the absence/compromise of sensorimotor systems (e.g., by disease) will necessarily impair conceptual processing (even though it may happen in some cases). There are compensatory mechanisms involved in the conceptual organization (*ibidem*). Thus, grounding concepts is something that the mind does, and it explains part of our rich and varied capacity of understanding language.

The binary question about the grounding of language processing is only absurd if we have to defend that processing the word "dog" is always as abstract as pulling some vague definition from a dictionary "canine, has teeth, has fur" or always sensorial. Language

processing is a contextualized phenomenon, and our cognition is adaptive. Every event is unique and meaning can be as rich or as elusive as the context demands.

The idea that many (if not all) effects in cognitive science are modulated by the characteristics of the task proposed in the laboratory, instead of being "absolute" (i.e., found in all conditions) is recognized by many scholars. Schotter et al. (2014) explain how the frequency effect of words (i.e., words that are used more frequently tend to be recognized faster) is not fixed and independent of the task. In a word search task, it is common to find small word frequency effects; in a text comprehension task, we find stronger effects, just as in lexical decision tasks; and in a mindless reading task, no effect is found (SCHOTTER *et al.*, 2014). Thus, word frequency effect is contextual.

The most well-known perspective about sentence comprehension is that language processing is a linear combinatorial phenomenon, in which we process each word in sequence and add the meaning of each word to derive the meaning of the full sentence. But as one might expect, language processing is far more complex. Read the sentences below (FERREIRA; YANG, 2019):

(i) "Each day is better than the next."

(ii) "No head injury is too trivial to be ignored."

(iii) "This book fills a much-needed gap in the literature."

(iv) "How many animals of each sort did Moses put on the ark?"

People often trust that there is nothing wrong with how they have interpreted those sentences, but often, they get them wrong. While people think that sentence (i) means "each day is better than the last" (i.e., days are getting better), the sentence is actually saying the opposite (i.e., each day is getting worse). While people think that sentence (ii) means that "no head injury, even if it seems trivial, should be ignored", the sentence is actually saying that "you should ignore all head injuries, even the ones that are trivial". While people think that sentence (iii) is saying that "this book fills an important gap in the literature", the sentence is

actually saying something like “there is a gap in the literature that is much needed, but the book is filling this gap”. Not to mention that people hardly ever notice in (iv) that it was not Moses who had an ark, but Noah.

One of the ways scholars explain this type of “mistake” is by suggesting that people do not fully engage with the reading of the sentences - they achieve a “good enough” processing. The good-enough approach to language comprehension holds that language processing is sometimes only partial and that semantic representation is often incomplete (FERREIRA; BAILEY; FERRARO, 2002). Regardless of the many models that we might propose to account for this and other phenomena in language processing, the “combinatorial” model cannot be deemed an absolute model, while everything else is considered “noise”. This is not a satisfactory account of language; it is merely an idealized one.

The “A-not-B error” is a very well-studied cognitive phenomenon. Piaget (PIAGET, 1954) devised this test to study how children develop what he thought was a “new cognitive structure” that enabled the child to understand object permanence. The test consists of hiding a toy under one of two pieces of cloth placed in front of the child *as it watches*. When one hides the toy twice under cloth A, the child correctly finds the toy. But when the toy is hidden under cloth B, the child under 10-12 months reaches, erroneously, for cloth A to find the toy that had been hidden there previously. This is a very robust finding under very generic conditions. However, with more studies, scholars discovered that this effect is context-sensitive. Smith et al. (SMITH *et al.*, 1999, p. 236) point out that:

> The literature also reports that the error requires a delay between the hiding event and the infant's action. The error does not occur reliably at any age if the infant is allowed to search immediately after the object is hidden (Diamond, 1985; Gratch, Appel, Evans, LeCompte, & Wright, 1974; P. L. Harris, 1973; Wellman et al., 1987). This, then, is an error that emerges over time, in the wait between seeing the goal disappear and being allowed to act. Further, the delay necessary for the error increases with age: 8-month-olds require a delay of at least 3 s, whereas 10-month-olds require a delay of at least 5 s (Wellman et al., 1987; see also Diamond, 1985). Thus, dynamic changes in memories between hiding and searching appear to be central to the error, and these dynamics change with age.

Perone et al. (2017) explain that the A-not-B error is not caused by a lack of a cognitive structure that is later acquired but by the combination of multiple factors, such as memory,

attention, inhibition, and motor planning, posture, and features of the task space. None of these components is more important than the other, and behavior emerges from their interactions in the context. Other important factors that modulate the effect are "visual properties of the hiding locations, their transparency, their number, the delay between hiding and search, search for people versus objects, and search in the home versus in the laboratory" (SMITH et al., 1999, p. 236). Interestingly, infants make the error when the task demands that they reach for the hidden object, not when it demands that they look at the object (HOFSTADTER; REZNICK, 1996).

Another interesting phenomenon happens in the test of creativity famously devised by Guildford (GUILFORD, 1967). In this test of divergent thinking, participants are asked to list things that they can do with a paperclip, for example, use it to open a door, make a barbie hanger, make an earring, etc. Participants that can come up with more examples (which are evaluated by researchers using some stipulated metrics) in a short time span are deemed to be highly intelligent and creative. However, the exact way that the question is framed can affect the number of participants that will score high on the test. Forthmann et al. (FORTHMANN *et al.*, 2019) explain that depending on the specific instructions (i.e., "think of as many ideas as possible" or "think of ideas that are creative") as compared with instructions that keep the goal opaque, substantial variations in participants' strategies are to be expected. Moreover:

> [...] "be-creative" instructions are assumed to homogenize participants' mindset toward the task and more demanding strategies can be expected to be used from the beginning (NUSBAUM; SILVIA; BEATY, 2014). Guilford (GUILFORD, 1968) argued also that explicit instructions to generate rather creative responses are likely to change the cognitive processes during idea generation. He expected a stronger involvement of evaluative processing with explicit instructions, which is in line with recent work by (NUSBAUM; SILVIA; BEATY, 2014). As a consequence, the involvement of evaluative processing should be more homogeneous across participants when receiving explicit instructions to be creative as compared to be-fluent instructions. Thus, multidimensionality of creative quality of low-fluency and high-fluency ideational pools seem to be more likely under be-fluent instructions.

Thus, in the "be creative" context, most participants tend to perform similarly, which is a remarkable finding if we are pursuing means to measure intelligence and creativity (and to differentiate people in society).

Likewise, Liberman et al. (LIBERMAN; SAMUELS; ROSS, 2004) found that the way you frame an activity matters for how people behave. The well-studied prisoner dilemma shows that humans have a bias to cooperate even when not cooperating might seem the best option. In short, if two people betray each other, they both get a medium punishment. If both cooperate,

both get a smaller punishment. However, if one betrays while the other does not, the one who betrayed gets the smaller punishment (or the biggest reward) while the one who cooperates gets the biggest punishment available. Thus, betraying seems quite an opportunity, but people rarely do so. Liberman et al. (2004) studied the prisoner dilemma while framing it as a game either called “the community game” or “the Wall Street game”. People who played the “Wall Street game” cooperated only 33% of the time, compared to people who played the “community game”, who cooperated 67% of the time. This is an effect created by people’s construal of the situation, which is affected by their beliefs about “wall street”.

In the same vein, much is said about how terrible humans are with statistics. Tversky and colleagues (KAHNEMAN; SLOVIC; TVERSKY, 1982; TVERSKY; KAHNEMAN, 1983) presented participants with a story about a feminist character named Linda and asked them which is more probable: (a) that Linda is a bank teller or (b) that Linda is a bank teller and active in the feminist movement. Most participants chose alternative b. This was explained as a “conjunction fallacy” because the probability of two events cannot be greater than the probability of one. However, changing the way the event is described can change participants’ performance in the experiment. Gigerenzer (GIGERENZER, 1991, p. 262) explains that by rephasing the experiment as follows: "How many out of 100 cases that fit the description of Linda are [a] bank tellers and [b] bank tellers and active in the feminist movement?", the supposed fallacy decreases from 77% to 27% (FIEDLER, 1988). That is:

> "Which alternative is more probable?" is not the same as "Which alternative is more frequent?" in the Linda context. Tversky and Kahneman (1983) found similar results, but they maintained their normative claims and treated the disappearance of the phenomenon merely as an exception to the rule (p. 293) (GIGERENZER, 1991, p.262).

The impetus to defend normative claims is widespread in classic cognitive science. But cognition is complex, dynamic, and adaptative. Thus, in this perspective, we see cognitive processes as resulting from different partial factors, which depend on the many ways that individuals and tasks differ, and how they interact. When considering the relationship between metaphors and cognition, we can use experiments to test some combination of factors and how they result in Conceptual Metaphors typical schemas being part of meaning. But we can also expect that under other conditions, they are not (if this is so, we need more complex theorizing about metaphors and cognition). The consequence of this approach that seems to bother many traditional scholars (especially those that support the “absolute position”) is that the theory is

not falsifiable in an absolute sense; it is falsified under certain conditions. The idea here is that multiple factors constrain how metaphors are processed and no experiment captures every factor. Moreover, our binary distinctions between novel and conventional, deliberate and non-deliberate metaphors are just useful approximations for something more complex and resultant of multiple interacting factors. It is not wrong to divide cognition binarily (or even in modules) - it is a useful theoretical choice. But other approaches to cognition consider it continuous.

## 6.3 Conceptual Metaphors

CMT started from the observation that many metaphors we use in our daily lives have conceptual similarities, even when the linguistic expressions used are different. For example, "our marriage is on the rocks", "our relationship hit a dead-end street", "we are spinning our wheels", are all different expressions when we look at the words that constitute them, but they all seem to imply that relationships are in some sense to be understood as journeys, thus they are conceptually related. A survey of our language will reveal that these patterns of conceptual similarity between linguistically diverse metaphors are very frequent in most, if not all, languages. This is what we call "the systematicity" of metaphors, and we know that there are thousands of these systematically related metaphors. Another way of saying this is that some metaphors are generative.

To illustrate with another example, "we are wasting our time", "invest more time in your studies", "I saved time by skipping a class", all convey the idea that TIME IS MONEY. "Time" is the target domain and "money" is the source domain. This means that we use our knowledge about "money" to understand and talk about "time"[21].

Why do metaphors often exhibit this systematicity? Our first hypothesis could be that metaphors (i.e., linguistic expressions) are semantically similar because of historical reasons. That is, when these metaphors were first created, people were aware of their similarities and shared motivations, but modern speakers do not have knowledge regarding the interrelatedness of metaphors.

[21] See more at: http://www.lang.osaka-u.ac.jp/~sugimoto/MasterMetaphorList/metaphors/, accessed in July, 2021.

Lakoff and Johnson's (1980) hypothesis was different. The authors proposed that speakers do have unconscious knowledge about the interrelatedness of semantically similar metaphors. This claim unfolds into the following:

(i) metaphors that are semantically similar share the same conceptual structure. In the case of LOVE IS A JOURNEY metaphors, the conceptual structure would involve mappings between lovers and travelers, relationship and vehicle, difficulties and obstacles, etc.;

(ii) this system is a fixed set of correspondences (cross-domain mappings) and inferences;

(iii) the conceptual structure of metaphors is accessed automatically and unconsciously every time one uses a metaphor.

Thus, not only do people have a conceptual structure that is responsible for the association among many systematic metaphors, but this structure is also responsible for processing metaphors unconsciously by cross-domain mappings. The metaphors that we use every day are "alive", even if people do not realize it (due to their unawareness of their own unconscious processes).

CMT has developed in many ways as authors have tried to account for what knowledge we have in our conceptual systems (or in our semantic memories) that explains the systematicity of metaphors. The idea that this knowledge is a fixed set of correspondences always accessed en bloc is deemed implausible today. One of the reasons for this is that cognition is adaptive (as discussed in the last section). As Gibbs (2017, p.115) points out:

> The generality at which implicit metaphors can be identified, and the family of metaphors to which a particular expression belongs, may therefore be indeterminate. Different individuals may interpret the same expression according to different implicit metaphors and derive different entailment. This possibility does not imply that conceptual metaphor theory (CMT) is circular or untestable. Nonetheless, there may not always be singular correspondences between specific verbal metaphors and particular underlying conceptual metaphors".

And:

> [...] conceptual metaphors are not necessarily accessed en bloc, with all their possible entailments spelled out, but can contribute partial constraints on people's metaphorical

> behaviors. This dynamical view does not deny that conceptual metaphors are an entrenched part of human cognition, yet sees the influence of conceptual metaphors in thought and language as a continually emergent process, serving multiple adaptive purposes in everyday life (GIBBS, 2017, p.220).

We will not discuss the many phases of development of CMT, but here is what we need to have in mind to follow through with our plan to explain what conceptual metaphors are.

A- We need to explain the systematicity of metaphor both as general distributed patterns, and as part of a single utterance.

B- We need to explain when metaphors are processed in any way that resembles what CMT has suggested. Some experiments show support for CMT (cf. GIBBS, 2017), but there are also experiments that show that metaphors can be processed by other processes and information that were not predicted by CMT (HOLYOAK; STAMENKOVIĆ, 2018). Are conceptual metaphors analogies?

C- What gets mapped (from source to target domains) during metaphor production and comprehension?

D- When are metaphors embodied (and in what ways)?

## 3.1 What conceptual metaphors are

To understand what conceptual metaphors are, we need to discuss some issues related to the points we raised earlier:

**A- We need to explain the systematicity of metaphor both as general distributed patterns, and as part of a single utterance.**

Metaphors are generative, which means that the pairing of two domains can result in plenty of viable metaphors, which are constrained by experience, goals, level of knowledge, belief systems, etc. Behuniak (BEHUNIAK, 2011) has written a full paper exploring the analogies between Alzheimer's disease and Zombies. Any metaphor can be extended in unpredicted ways. LOVE IS A JOURNEY metaphors has its more usual expression, such as "we are spinning our wheels", but we can always generate new ones, such as "Grab your passport in my hands" (meaning our love journey is about to begin), "Like a drifter, I was born to walk alone", "My heart is like an open highway", "there is no shortcut for love", "I have the wrong map for love", and "my love compass is broken". Metaphors can be extended in multiple ways because abstract concepts are as rich as our experiences with them.

It is possible to say that no metaphor is a priori ruled out as "nonsense", we just need the right context/experience for it to become meaningful. This means that trying to establish a rigid schematic structure for all conceptual metaphors is not needed. However, some metaphors do show some logical chaining. For instance, the metaphor RAGE IS LIQUID IN A CONTAINER exhibits the following connection: when a person is mad, she is "boiling", when she is madder, she is "fuming", and when things get worse, she "explodes". This is much like the sequential nature of what we know about the workings of liquids in a pressure cooker and modern speakers have this knowledge (GIBBS, 2017). But trying to constrain all conceptual metaphors to this format is unnecessary. What modern speakers unconsciously know about conceptual metaphor is likely to depend on the type of metaphor and on the speaker. Not to mention that the knowledge a speaker will use to interpret a metaphor will depend on many other factors, and may not be consistent with conceptual metaphor theory (e.g., attributive knowledge).

Other metaphors present a different distributive pattern. For ALZHEIMER IS WAR, we can say that the patient is a victim (of Alzheimer's) or that the caregiver is a victim (of the patient). We can cast the caregiver or the scientists in the role of the hero. The flexibility of metaphors is not predicted by semantics, but by experience. Thus, conceptual metaphors are not fixed schemas in the mind. The existence of one type of metaphor (e.g., War metaphors for disease) biases thought in making it more likely that we will use War metaphors when conceptualizing diseases, but it does not determine that we must.

The nature of the relationship between metaphors in semantic memory is varied, in terms of connections, and it is distributed on many levels, and ever-changing as our experiences change. The knowledge we have about the world cannot be captured by simple fixed structures. Our semantic memories are always changing as we gain more knowledge about the world.

One of the characteristics of the semantic memory that CMT has pointed out and that can be implied by our studies of metaphors is that knowledge, in some sense, is organized in useful ways. Obviously, we know what kinds of things come first and what comes next in a typical experience of some kind. So it is right to expect that metaphors will highlight some of these common patterns of experience. In a war, we first think of strategies to win the war, then we fight, then we win or lose; in a discussion, we first think of strategies to win the discussion/war, then we fight/argue, then we win or lose. But metaphors are much more than these patterns, especially in different contexts that might select different aspects of meaning. What was wrong with CMT was to propose that metaphors were a matter of projection instead of matching information.

**B- We need to explain when metaphors are processed in any way that resembles what CMT has suggested. Some experiments show support for CMT (cf. GIBBS, 2017), but there are also experiments that show that metaphors can be processed by other processes that were not predicted by CMT (cf. MCGLONE, 1996). Are conceptual metaphors analogies?**

This is not a conceptual metaphor, but let's think about this example of a metaphor in a Beyoncé song. The song is about a break-up with a boyfriend that did not value her. Later in the future, she realizes, gratefully, that he is the best thing that she has never had:

*Thank God you blew it*

*I thank God I* ***dodged the bullet***

*I'm so over you*

Not being a native speaker of English, I found myself wondering, for a moment, if the idiom "**dodged the bullet**" was a modern version of "avoiding the cupid's arrow". In other words, I wondered if this metaphor was specific to the domain of love. A week later, I was at a bar talking to a friend and he said that I was lucky not to experience any side effects from the covid vaccine. Automatically, without any further thought, I found myself making the movement of "dodging the bullet", as I said, "I dodged the side effects". At that point, I realized that (i) the metaphor was not exclusive to the domain of love; (ii) my mind had already picked up on different levels of information and understood that it means something like "avoid anything that can harm you" (do not mistake the paraphrasing with the nature of the content of idiom in the mind). Thus, to Beyoncé, her womanizer boyfriend was the bullet that could have harmed her feelings (and even messed up her life), but she dodged it by breaking up with him. In my case, the side effects of the vaccines were the bullet that could have harmed my body, but I dodged it by having the right biological response.

When I said "dodged the side-effects", just like Beyoncé, I moved my body as if I were dodging a real bullet. My point in giving this example is that, frequently, metaphoric gestures and movements are said to support Conceptual Metaphor Theory (GIBBS, 2017). But we can embody any metaphor. What are metaphoric gestures and movements evidence of? They are evidence that, contrary to what some scholars have suggested, conventional metaphors are not dead - at least in some contexts. They are also evidence of the schematic/embodied nature of our conceptual systems - these schemas are used at least in some contexts (not necessarily all). Instead of imagining a conceptual system made of bits of disembodied information, we can say that gestures (e.g., moving your hands in a tortuous way as you talk about life being a journey, full of pathways) are evidence of the schematic nature of our conceptual system - even though there is more to our conceptual system than schemas (VIGLIOCCO *et al.*, 2009).

Gestures are evidence of one aspect of the nature of our conceptual system and of the liveliness of conventional metaphors, but they are NOT evidence that metaphors are always processed as Lakoff (1993, 2008) has proposed (i.e., by a system of cross-domain mappings).

Consider this example of conceptual metaphors in use:

*Brazil was at the edge of a cliff, but it took a step forward.*

At one level of analysis, the sentence consists of serious information: Brazil was having problems, but it was able to make progress. However, when we consider the metaphoric scenario, we are faced with a joke that implies that Brazil was at the edge of a cliff, and by taking a step forward, it fell (its situation got worse). Thus, at one level we have a coherent positive/serious message about Brazil. But by simulating the metaphoric scenario we can see the contradiction and understand the joke. **My point here is that we should not confuse the schemas described by CMT with the only, the main, or the most important level of information of metaphors.** CMT reveals one level of information about metaphors - which other theories ignored. But it does not explain everything, and it does not predict when this level of information is needed in metaphor processing - and it is not always needed.

One of the central disputes over conventional metaphor processing concerns the possibility that it is - sometimes, but not always - processed unconsciously and automatically by cross-domain mappings. And by cross-domain mappings, we mean any stored analogical matching of information. At this point, we must also try to specify what analogy is, and there are many accounts of analogy. Here we consider analogy to be a matching between information that is not necessarily identical but similar and that can be said to be found independently in the two domains of experience or knowledge. For example, the shape of an hourglass is (by human biological and cultural standards) similar to the shape of women's waists (this is a perceptual analogy). Humans think sharks are vicious creatures and lawyers behave in ways that are cruel (this is an attributive analogy). Physical fights and wars involve physical aggression, planning of strategies, winners and losers; verbal fights and wars involve verbal aggression, planning of strategies, winners and losers, etc. (this is a schematic analogy). It is likely that in some contexts this schematic, analogous knowledge is active (cf. GIBBS, 2017; THIBODEAU; DURGIN, 2008). More precisely, we need more tests to figure out (i) if this information is active in the first seconds of processing a metaphor and then becomes less active as the context selects the meaning of the metaphor. And (ii) if, provided that the context is NOT biased to the schematic knowledge, and the metaphor is presented within this context, the schematic knowledge is still accessed. These two questions are meant to tackle this one problem: do we always access to some degree the schematic meaning of a conceptual metaphor or is it dependent on the context? At this point, we have reasons to believe that cross-domain mappings are not always active when we process a metaphor, but can be, even unconsciously, in some situations (THIBODEAU; DURGIN, 2008; THIBODEAU; BORODITSKY, 2011).

**C- What gets mapped (from source to target domains) during metaphor production and comprehension?**

The problem of establishing what gets mapped in metaphor production and comprehension has always plagued cognitive linguistics. See how Kövecses (KÖVECSES, 2019, p.22) disagrees with Lakoff on this metaphor analysis:

> The particular example Lakoff uses to demonstrate superficial metaphors is that of the safety net. He illustrates the metaphor from a newspaper article: "Senator Phil Gramm told a college commencement audience that the social safety net erected by government by the New Deal and the Great Society had become a 'hammock' that is robbing the country of freedom and virtue" (from Lakoff 1995, http://www.wwcd.org/issues/Lakoff.html). Lakoff offers an interpretation of the metaphor along the lines of his book Moral Politics (1996). He states that "[t]he tightrope is straight and narrow – a moral path." This is based on the well-known conceptual metaphor moral is straight. Given the metaphor, walking the tightrope corresponds to working and falling off to losing your job. In addition to this interpretation, several other metaphors seem to be equally possible in understanding the passage. One of these would be the conceptualization of actions in general as motion. Another would take into account the balancing act of the tightrope walker. Furthermore, we can think of the movement of the tightrope walker as a life-related metaphor having journey as its source domain. Finally, we can interpret the situation depicted by the sentence as a combination of controlling and life-action metaphors, in which controlling life amounts to keeping a job.

The basic idea to have in mind is that the use of the metaphor "safe net" implies that citizens are walking on a tightrope. The implied "tightrope" may have different connotations and schemas. The most striking difference between the two metaphor scholars' analyses (i.e., Lakoff versus Kövecses) is the fact that Lakoff's analysis is tinted with left-winged accusations (for example, it implies that walking on a tightrope is a moral path - which might be an apt or inapt interpretation depending on the context). On the other hand, Kövecses suggests that the tightrope implies the need of balancing jobs and other life demands. Anyone can lose balance, since life may shake you in unforeseen ways (e.g., you may get a life-threatening disease, lose your job, etc.). Contrary to Kövecses who presupposes a multilevel analysis in which CONTROL IS PHYSICAL BALANCE, we would suggest that physical balance is an idealization of having a balanced life, one in which the many demands of life (e.g., working, caring for your health, caring for your family, etc.) are attended to in an "equilibrium". If you cannot maintain the idealized equilibrium, you may fall. Maintaining equilibrium does not need

to be a matter of control, it can be a matter of responding well to the world, adapting, or even being lucky or fit so as to not experience so much agitation. Regardless, it is also possible that for some people in some situations, the "safety net" only means "security", and nothing else. **The bottom line is: linguists don't know how a metaphor will be processed/interpreted. Nobody knows.** We can talk about meaning in probabilistic ways, for example, "people tend to process this metaphor in one way or another". But no one knows how anybody will interpret a metaphor or the exact type of information accessed during this interpretation.

The idea that metaphors can be decomposed into schemas, frames, domains, etc., as suggested by Kövecses (2017; 2019), needs further investigation. We can reliably assume that this is not always the case, but this might happen in some conditions (we will get back to this soon).

Ultimately what will get mapped depends on the interaction of different variables. And might include: attributes, structures, schemas, valence, etc. In an experiment (similar to McGlone's, 1996), we asked participants to substitute the metaphor in bold for another word with similar meaning. See the diversity of responses in the examples below, which involves attributes (e.g., complicated), primary metaphors (e.g., ups and downs), and journey related schemas (e.g., "we don't know where this is going"):

A- Our relationship is a **rollercoaster ride**.

1. *Our relationship is intense, full of ups and downs and we do not know where this is going.* [CD] [CMOD] [CMOD] [CM]
2. *Our relationship has ups and downs.* [CMOD]
3. *Our relationship is unstable.* [A]
4. *Our relationship has ups and downs.* [CMOD]
5. *Our relationship is unstable/messy*. [A] [A]
6. *Our relationship is unpredictable.* [A]
7. *Our relationship is an up and down of emotions.* [CMOD]
8. *Our relationship is full of ups and downs.* [CMOD]
9. *Our relationship is complicated.* [CD]

If we consider the multiple conventional meanings a conceptual metaphor may have, it is important to realize that not all of them are studied under CMT. For example, "Life is a

journey" can conventionally mean different things. In "life is a journey, not a destination", it means "process". In "a kid is at the beginning of his journey", it sets up a schematic knowledge (beginning-middle-end). In "life is not a journey", it generally means it is not fun/pleasurable. And it can also mean "long" for some people, as in the replies to an experiment we have conducted. This is important to have in mind since in the next section we propose that deliberate metaphors generally imply deviations from conventional ways of processing metaphors. And the conventional ways to process metaphors are diverse.

We must also understand that while CMT emphasizes domain-level aspects of metaphors (i.e., that "my relationship is a rollercoaster-ride" and "this relationship is a dead-end street" are semantically associated), there is much more information in metaphors. For example, "my relationship is a rollercoaster ride", "my emotions are a rollercoaster ride", and "adolescence is a rollercoaster ride" are metaphors supposedly from different domains (relationship, emotions, and adolescence), but which share the same information: all can have ups and downs, all can be tumultuous, etc. Thus, metaphors that are not from the same domain also share similar properties and are related in some way, or can be processed similarly depending on the context.

**D- When are metaphors embodied (and in what ways)?**

As we have discussed previously, metaphors do not always need to be processed by resorting to schemas, as proposed by CMT. It can potentially be processed by more abstract knowledge (e.g., attributes). We would consider metaphors embodied if we can detect in neuroimaging studies that sensorimotor areas are active in processing metaphors (LAI; HOWERTON; DESAI, 2019). We would also consider metaphor embodied if it is accompanied by metaphoric gestures (CIENKI; MÜLLER, 2008) or if it can be primed by gestures (WILSON; GIBBS, 2007). Phenomenological metaphors are also embodied, such as when the metaphor "love is addiction" is used by a person who is experiencing the physiological changes that accompany addiction.

Primary metaphors are considered embodied because they are based on co-occurrence of experience. It does not mean, again, that processing primary metaphors need always involve embodied aspects of meaning. But experiments show how these metaphors can affect higher-order cognitive processing, which was previously considered disembodied. For instance,

Siqueira e Lamprecht (SIQUEIRA; LAMPRECHT, 2007) asked kids to touch two identical pads that had dots for eyes and a straight line for a mouth, representing a “neutral face”. One of the pads was cold and the other was warm. The scholars asked kids which one of the pads had stronger emotions. Kids chose the warm pad as having stronger emotions: “Because it is hot. Strong emotions mean hot”, said a 5-year-old participant.

Williams and Bargh (WILLIAMS; BARGH, 2008), in a popular experiment that has not been replicated outside the lab (CHABRIS *et al.*, 2019), had a confederate ask participants to hold either a warm or a cold cup of coffee. This request was made as the confederate took some notes on the names of participants. Later, he asked participants to evaluate the personality of a character considering many traits. As a result, participants who held the warm cup evaluated the character as more warm, affective, etc.

Zhong and Leonardelli (ZHONG; LEONARDELLI, 2008) asked participants to narrate either a story about a situation in which they were rejected or a situation in which they were socially accepted. When they finished narrating the story, the scholar told them that there was a problem with the air-conditioning system and asked them if they could estimate the room temperature. Scholars found out that participants who had told a story about social exclusion reported lower temperature levels than those who had told a story about social acceptance.

The experiments reported above suggest the plausibility of the mapping AFFECTION IS WARMTH, which underlies many linguistic expressions (even if results emerge in specific contexts). Other experiments that support these primary mappings cover, for instance, IMPORTANCE IS WEIGHT (ACKERMAN; NOCERA; BARGH, 2010), DIFFICULTY IS HARD (XIE *et al.*, 2016), MORAL IS CLEAN (ZHONG; LILJENQUIST, 2006), POWERFUL IS UP (ZANOLIE *et al.*, 2012), DESIRE IS HUNGER (GIBBS, Raymond W.; COSTA LIMA; FRANCOZO, 2004), etc.

Interpretation of primary metaphors also seems to involve embodied (phenomenological) knowledge. Siman *et al.* (in press) asked participants to explain the analogy motivating the metaphor “John is a cold person”. Even though explaining analogies is a difficult task for speakers, some of them reported on bodily sensations, such as:

> *When a body is taken by emotions, we feel hormonal injections in our bloodstream which bring the sensation of warmth to the body: sweat, agitation, etc. The coldness mentioned is related to people who are not moved by these hormonal and emotional shots and keep calm and sterile in critical or intense situations*.

Embodiment is a much broader concept that is meant to capture the idea that cognition is a product of the interactions between body, brain, and environment (GIBBS, 2005; PAOLO; CUFFARI; JAEGHER, 2018; SPIVEY, 2008). My brief presentation of the subject here was meant to emphasize some of the empirical observations relevant to metaphor scholars.

## 6.4 Deliberate Metaphors

Steen's Deliberate Metaphor Theory is a semiotic approach to metaphors, in which deliberate metaphors are said to be those which are used as metaphors in communication. Deliberate metaphors present an external perspective on the target domain of the utterance (REIJNIERSE *et al.*, 2018; STEEN, 2017). Or yet: "A metaphor is potentially deliberate when the source domain of the metaphor is part of the referential meaning of the utterance in which it is used" (REIJNIERSE *et al.*, 2018, p. n/p). Under this definition, novel metaphors are deliberate (e.g., "And although he **put rivals to the sword** in the New York primary this week, Trump appears to be looking over his shoulder…"), but conventional metaphors (e.g., Hillary Clinton **attacks** Bernie Sanders) are not. Conventional metaphors are "just the way we say" things.

The idea that conventional metaphors are not processed by cross-domain mappings was attacked by scholars since there is evidence to confer a special status to these metaphors. Even when they are processed unconsciously, conventional metaphors can result in cross-domain mappings and can affect reasoning (THIBODEAU; BORODITSKY, 2011; GIBBS, 2017). Moreover, the reliance on a communicative dimension to establish how metaphors are processed has limitations. A metaphor used deliberately may fail to be processed as such, and a metaphor not used deliberately may be processed with special attention to it, just because of people's special circumstances or interest in the metaphor.

The exact way a metaphor will be processed depends on many factors, for example, on the person's familiarity with the metaphor, task, what types of information have appeared in the

text previously (i.e., a priming effect), etc. Obviously, the analyst who is looking at a metaphor in a text cannot determine how a metaphor is to be processed. Processing depends on the people and the situation encountered. Nevertheless, classifying metaphors is something linguists do for different reasons (e.g., to count the prevalence of metaphors in different texts). Thus, linguists need a convenient schema to classify metaphor, and this is what Steen's work generally tries to capture. The methods of identifying metaphors are useful for academic purposes (GROUP, 2007; STEEN *et al.*, 2010), but should not be confused with an explanation of how cognition works.

The same is true for identifying deliberate metaphors in a text - our procedures should not be equated with mind reading. In this paper, we take a slightly different approach to deliberate metaphors: we consider metaphors deliberate when their mode of processing deviates from conventional ones. Processing conventional metaphors involve automatic and unconscious different modes of processing. The same conventional metaphor can be processed either by access to schematic or attributive information (among others). In some contexts, there can be a significant deviation in these modes of processing. For instance, the meaning of a metaphor can switch in context or can remain the same, but some other aspects of its construction can be highlighted (see examples below).

Under this perspective, we are not interested exclusively in a 3-D account of metaphors. That is, we are not exclusively interested in metaphors that are used as metaphors in communication. A metaphor can be deliberate even if they do not show any marks of deliberateness. In this case, we probably cannot analyze it, but it is important to acknowledge that cases like this may occur. And a person can process a metaphor as deliberate even though it was not marked or even intended as deliberate by the speaker. For example, one can say "Life is a journey" as the listener might have just read about a journey and come to interpret this metaphor to mean something that the speaker had never intended. Thus, deliberate metaphors may be used as metaphors for some communicative goal, but it must not always be the case.

Metaphors' meanings may deviate from their conventional meanings in different ways. Let's consider some of them. The first way in which we certainly see this deviation and notice a communicative goal is in humorous metaphors. One of the phenomena used in humorous metaphors is the access to two meanings, which deviated from our everyday use of metaphors. For example, the irony "This work is as **fruitful** as a butcher shop", evokes both the meaning of "productive", which (regardless of being processed by cross-domain mappings or not) is

conventional and the meaning of "having fruits", which is something butcher shops do not have. This deviates from at least one of the conventional meanings of the metaphor, most typically, only the "productive" sense of it. The puns below display the same double meaning:

> My girlfriend borrowed $100 from me. After 3 years, when we separated, she returned exactly $100. I lost **interest** in that relationship.
>
> And now you're just left a loan.
>
> You deserve **credit** for this.

The word "interest" is meant to evoke both the conventional meaning of "wanting to know" and the meaning of "monetary adjustment". The word "credit" is meant both as "public acknowledgment" and as "money lent". In this case, none of the meanings deviates from the conventional, but the humorous effect makes the metaphor deliberate because it draws attention to both meanings, which is not how we tend to process it in most conventional conditions. Yet another case is Tim Minchin's song:

> You **grew on me like a tumour**
> And you spread through me like malignant melanoma
> And now you're in my heart
> I should've cut you out back at the start
> And now I'm afraid there's no cure for me
> No dose of emotional chemotherapy
> Can halt my pathetic decline
> Should've had you removed back when you were benign
> I picked you up like a virus
> Like meningococcal meningitis
> Now I can't feel my legs
> When you're around I can't get out of bed
> And I've left it too late to risk an operation
> There's no chance at all of a clean amputation
> The successful removal of you
> Would probably kill me too

The metaphor “you grew on me” means, conventionally, that “I started to like you more with time”, is a growth of feelings. In this humorous song, this growth is both of feelings but also of a metaphoric tumor that should have been removed at the beginning of the relationship. The development of the scenario of a cancer complication as an analog to the scenario of falling in love is a play on conventional metaphors, which draws attention to its metaphoricity.

We can draw attention to metaphors for reasons other than humor, for example, to show that we are aware of the convenience of the metaphor to the subject we are discussing (which is a case of metaphor used for communicative goals):

> [...] Instead, he closes out the book with the analogy of cultivating a garden, of dedicating ourselves to something that will require “a lot of work without immediate gratification.” Given the book’s emphasis on not just confronting difficulty but delving into it, the gardening bit feels a little too comfortable and familiar. Rhetorically, though, it makes sense: The metaphor of a plant is easier to accept than the chaos of another. Davis’s point is that we have to start somewhere. **He has planted a seed with this book. Now watch it grow.**

A different way in which metaphors deviate from their conventional meaning is in the following example: “I’m not a stop along the way. I’m a destination.” The conventional metaphor RELATIONSHIPS ARE JOURNEYS usually implies that lovers are travelers. But in this use, lovers are stops along the ways and destinations. In the case of “My wife is an anchor” - which can have different meanings (see KÖVECSES, 2015), lovers are anchors and ships. In the case of “I am your harbor”, lovers are harbors, not travelers. And in the case of This Mortal Coil song’s “Swim to me, let me enfold you”, lovers are a traveler in a ship and a siren. Of course, all these metaphors might become conventional one day. The important aspect to notice is that the typical matching of lovers to travelers is altered in these metaphors, making them deliberate.

Metaphors can deviate from their conventional meaning by adding novel elements to conventional ones. For example, in Taylor Swift’s songs “Grab your passport and my hand, I can make the bad guys good for a weekend” and “Loving him was like driving a new Maserati down a dead-end street”, we see the usual schema of lovers being travelers in a relationship

which is a vehicle, however, these metaphors make use of novel elements. The “passport” and “Maserati” add layers of deliberate and deviant meanings to RELATIONSHIPS ARE JOURNEYS.

Metaphors are deliberate when they are explained, or when their mappings get spelled out, as in the example below. Notice that this person is explaining the meaning of the depth metaphor as set in a frame of “structures”. This might not be the meaning of this metaphor for all speakers.

> You know, and it’s sort of… it seems like to have a relationship with someone you have to get to know their **hierarchical structure,** right? And it’s just like… like the tiniest things while that person sits at the desk and types, well, it’s a **shallow** relationship. And if it’s a **deep** relationship you know much more about the **whole structure**, right? Which is I think why the metaphor of **depth** works so well.

Metaphors are deliberate when we repeat them (see the journey metaphor below) and explain them (see the digestion metaphor below). In this case, it is not a deviation of meaning, but a choice over a schematic meaning that is being made. This does not mean that the cross-domain mappings in these metaphors are not active at all in other contexts. The amount of activation might depend on how conventional and familiar a metaphor is. The prediction here is that the meaning is more likely to be embodied (and even include gestures) and that the mappings are more active in these situations. By contrast, it does not mean that absolutely all repetitions are deliberate.

> So it’s not a call to stupid **adventure**. What it does is assume that you’ve got a **direction** and the **direction** is a valid **direction**. And then what happens is, as you **pursue** that, **obstacles** emerge, anomalous, threatening **obstacles**, and then you either confront them, or you abandon the whole project. Well generally speaking if you **chop** them into **little pieces** then you can confront them and **digest** them. And then you get stronger because you’re doing all this **digesting**. It’s like you’re **eating the monster of chaos**. And that’s a classic metaphor for developing wisdom to **ingest**. Piaget even uses that, right? Assimilate. It’s exactly the same idea as **ingesting**. What you’re **eating** is information instead of matter. And the information restructures you and makes you more informed. And that puts you more in formation. So you know you encounter the anomaly and it’s a burst of

> contradictory potential, and so that's exactly how you respond to it. Your body's **going everywhere** at once, because God only knows what's going to happen. And then as you interact with it, it collapses. You're collapsing it. That's what happens when you take control of the situation. And then you reduce it to a single **path** where everything is **going** properly.

As we have mentioned, this is an approximation in trying to understand what a deliberate metaphor is. Of course, coding for deliberate metaphors would require some arbitrary choices because metaphors can be read differently by different people and under different conditions. A metaphor that I do not intend as deliberate, can be processed as a deliberate metaphor by you.

## 6.5 On the issue of cross-domain mappings

Even though more experiments on deliberate metaphors are needed, we suppose it is reasonable to suggest that "His work is fruitful" and "His work is as fruitful as a butcher shop" are processed slightly differently. The first one is a case of non-deliberate metaphor and the second is a deliberate one. The second case seems to activate a broader sense of "fruitful" that involves the information that butcher shops have no fruit, in which actual fruits are part of the meaning. The first case is less about fruits than it is about productivity, a conventional sense of the word (when we say less about x than y, we include the possibility that both concepts are probabilistically active). This is not supposed to mean that processing conventional metaphor is anything like retrieving meaning from a mental dictionary. However, if the metaphor is frequently used in very similar contexts, it is likely that some stronger meaning might be dominant (in this case, something along the lines of "productive"). The range of conventional meaning of a metaphor depends on the many different contexts we often use a metaphor, that is why we say there are "conventional modes of processing a metaphor".

The question about the mechanism of metaphor processing is a much harder one. For one thing, all we know about cognition is inferred, so we do not know any cognitive mechanism. Apart from that, many mechanisms have been proposed in the literature about metaphor processing: analogy, categorization, metonymy, and lexical disambiguation. Generally speaking, we know that the more conventional and familiar a metaphor is, the faster it is processed. And people seem to prefer novel metaphors in simile sentences rather than in metaphoric sentences. This has led Gentner and Bowdle (2008) to propose that novel metaphors are processed by analogy whereas conventional ones are processed by categorization. But some

novel metaphors can be processed just as fast as conventional ones, provided they are apt[22]. Glucksberg (2008) proposes that these apt novel metaphors are processed by categorization, just as conventional ones.

Thus, if we take all novel metaphors to be "deliberate metaphors" and if we say that deliberate metaphors are processed by analogy, this already contradicts experiments (because there are novel apt metaphors that do not seem to be processed by analogy). Unless we consider that what happens both with apt novel metaphors and some conventional attributive metaphors is analogy. Then conventional metaphor processing is (in some cases) automatic and unconscious analogies. Which is also inconsistent with Steen's proposals (2008, 2017).

And we must also acknowledge that there is something odd in the very idea that metaphors follow a career, which has been pointed out by Glucksberg (2008): different metaphors follow different careers.

The idea that metaphors follow a career plays out as follows. When novel, metaphors are processed as analogies. Then, when they become conventional, they are processed by categorization. All the way until the vehicle loses its association with the topic, which is when metaphors are just a case of polysemy (or a lexical entry). But let's try a slightly different explanation for metaphors' different careers.

Novel metaphors involve widespread activation of domains and cross-domain mappings. The time it takes to process them and just how widespread the activation is dependent on contextual and culturally salient information. Metaphors that are processed faster are those that encompass ideas that are easily identifiable and culturally shared (e.g., they capture dominant ideas/ideologies). For instance, "Alzheimer is a bulldozer" should be processed faster than "Alzheimer is a teacher" (of course, this is considering the general lay public, but the pattern could change for specialists in Alzheimer's who share a biopsychosocial model of the disease. Tests are still needed to corroborate this hypothesis). A second hypothesis is that, within these novel apt metaphors, metaphors that are more likely to be processed by accessing attributes are processed faster than metaphors that are relational. The easier way to test this hypothesis would be by priming people with attributive and relational properties of the same metaphor. Of course, the timing in these cases is not supposed to vary widely, but small variation would help us establish that some metaphoric processes are more costly than others

[22] Aptness my not be the right specification for this, we prefer "accessible culturally shared information".

(e.g., Primers: Straws are long/ straws take water up to the mouth. Target: Tree trunks are straws).

Different metaphors start out their careers differently. When novel, they can be processed by attributes or relational properties, they can be or inapt, they can have properties that are culturally salient or not, etc. Moreover, we are focusing just on the metaphor and pretending that people are all average and contexts are mostly absent. But in reality, people are different (e.g., different ideologies), metaphors are different, and contexts can be different. Processing happens at the intersection of many interacting factors.

The following question is: what happens when metaphors become conventional (when we use them over and over again)? Do they stop being processed by cross-domain mappings and start being processed by categorization? How? and Why? Do one day you just wake up and modes of processing change? Our hypothesis here is different. We use metaphors in contexts. The more similar the contexts, the more metaphor processing starts to get attracted to some meaning. This meaning can be the same original meaning that was available when metaphors were novel, or it can be something new, derived from the context (i.e., not reliant on cross-domain mappings - see Siman et al., *in press*).

Thus, metaphors can change their meaning if the frequent contexts we use them in create new meanings. But they can also keep the same analogical meaning that was derived when they were novel (either the faster attributional meaning, or some other meaning). The polemic lies in whether conventional metaphors are still processed by analogy (which at this point can be faster, because it has been performed many times), unconsciously. And this analogy can be attributive, schematic, relational, etc. It seems that even though the same conventional metaphor does not need to be processed by cross-domain mappings all the time (contrary to CMT), sometimes, it does, unconsciously (contrary to DMT).

## 6.6 Conclusions

In this paper, we have discussed how conceptual metaphors may have different meanings in different contexts. Many of these meanings are conventional, and we are mostly unaware of their processing. On the other hand, sometimes our metaphor processing deviates

from what is most conventional. These deviations, we argue, constitute what we perceive as "deliberate metaphors".

Deliberate metaphors are not necessarily about metaphors used as metaphors in communication. We can both use a metaphor deliberately regardless of the listener picking up on its deviant meaning and can process a metaphor in a deviant manner, even if it was not meant as a deliberate metaphor. Deliberate metaphors imply deviant modes of processing (from its conventional and most likely occurrences), regardless of our being able to spot them. It is important to have in mind that meaning is established from the interactions between speakers' backgrounds, metaphors, and contexts. Our analyses are useful approximations, which are conducted on arbitrary grounds for some scientific purpose (e.g., estimating the prevalence of metaphors in texts).

Most of our fights over metaphors imply different beliefs about what science is, what cognition is, what metaphors are, and how things should be done. Our hope is that scholars will be better trained to justify their analytical choices. All approaches to metaphors have limitations, but some are better for some goals than others. We must be mindful of our methodological and theoretical choices and their limitations.

> [...] there has been a natural but unfortunate tendency to "extrapolate," from the thimbleful of knowledge that has been attained in careful experimental work and rigorous data-processing, to issues of much wider significance and of great social concern. This is a serious matter. The experts have the responsibility of making clear the actual limits of their understanding and of the results they have so far achieved, and a careful analysis of these limits will demonstrate, I believe, that in virtually every domain of the social and behavioral sciences the results achieved to date will not support such "extrapolation."
> Chomsky, 2006.

> Market-related metaphors are not good or bad as stimuli for educational practice; instead, they are better or worse in particular contexts than are alternative metaphors.
> Browne et al., 1998.

## 7. How do metaphors shape thought in the wild?

### 7. 1 Introduction

In 2013, Al Vernacchio presented a Ted talk[23] pointing out how American metaphors about sex are based on analogies with baseball that highlight competition, where winners are generally men, and losers are generally women. Al Vernacchio proposed that we need a healthier way to think about sex and suggested we conceptualize it through the lenses of a novel metaphor, i.e. sharing pizza, whereby the competition frame is exchanged for that of mutual satisfaction. There are, in fact, at least ten Ted talks in which speakers urge us to change the metaphors we use to talk about important social issues. The academic literature is also filled with papers that cover the potential negative effects of metaphors in reasoning and behavior. Some go so far as to suggest that switching metaphors may help remedy social problems (BEHUNIAK, 2011; GEORGE; WHITEHOUSE, 2014; LANE; MCLACHLAN; PHILIP, 2013; NGATCHA-RIBERT, 2004). Recently, the urge to change metaphors has been captured by the project "reframing covid[24]", in which authors propose we stop using War metaphors to communicate about the pandemics (SIMAN; SAMPAIO; GONZALEZ-MARQUEZ, 2021)[25].

The idea that metaphors shape thought is controversial. It was famously suggested by Lakoff and Johnson (1980) and Lakoff (2014) and criticized by different scholars (PINKER, 2006; SCOVEL, 1991; WALKER, 2012). Regardless of the critiques, this is a major topic in

[23] Available at: https://www.youtube.com/watch?v=xF-CX9mAHPo&t=1s (access in June, 2021).
[24] Available at: https://sites.google.com/view/reframecovid/ (access in June, 2021).
[25] This chapter has been published as a paper here: https://seer.ufrgs.br/cadernosdetraducao/article/view/109332

Cognitive Linguistics and Psychology, as much as in social fields, because it raises the questions: when do metaphors affect our thoughts without us being aware of them? What are the consequences of it (to individuals or societies)? Should we change our metaphors? Under what conditions can a novel metaphor have the same impact as a conventional one? We believe that the admiration, skepticism, and puzzlement regarding metaphors and their role in reasoning derives from the fact that we do not (as far as we know) have an academically shared model of what metaphoric framing effects are and of how it relates to the literature, particularly, to Lakoff and Johnson's theory. Thus, our main goal in this paper is to suggest a model and discussion of how metaphors shape thought.

In this paper, we: (i) review some key aspects of the history behind the claim that metaphor shapes thought; (ii) discuss key psycholinguistic experimental evidence that metaphors shape reasoning; (iii) present two models of reasoning to help make sense of metaphor's role in reasoning; and, lastly, (iv) discuss some controversial questions that permeate the social sciences literature.

## 7.2 What theories predicted

Conceptual Metaphors (CMs) are metaphors that are entrenched in culture and, as claimed by Lakoff and Johnson, in our cognitive unconscious. CMs are systems of cross-domain mappings that are assumed to be automatically and unconsciously activated when we process metaphors that are based on (or consistent with) these systems (LAKOFF, 1993). There are thousands of systematic schemas ("in the conceptual system") that underlie everyday metaphoric expressions ("in linguistic outputs"). For example, the expressions "This relationship is going nowhere", "We are spinning our wheels", "Our marriage is on the rocks" are all instantiations of the conceptual metaphor LOVE IS A JOURNEY, which comprises cross-domain mappings whereby LOVERS ARE TRAVELLERS, RELATIONSHIP IS A VEHICLE, DIFFICULTIES (IN THE RELATIONSHIP) ARE OBSTACLES (IN THE JOURNEY) and so on (cf. LAKOFF, 2008).

When Lakoff and Johnson (1980) proposed that metaphors structured thought and influenced behavior, it was a controversial claim (GIBBS, 2011; 2017). At the time, the core discussions centered around whether conceptual metaphor provided structure to abstract concepts that would not otherwise have much content. It was assumed that abstract concepts

were almost entirely composed of conceptual metaphors, i.e., fixed and enduring projections from more familiar, structured, and concrete domains of knowledge to less familiar, less structured, and more abstract domains[26]. As Sauciuc (SAUCIUC, 2009, p.244) synthesized:

> CMT posits that only a few basic domains and concrete concepts emerge directly from bodily experience: e.g., spatial orientation, containment, force, and temperature. All abstract concepts – including emotion concepts – are indirectly grounded in these basic domains by sets of enduring metaphorical mappings, whose purpose is to assist understanding the more abstract concepts in terms of the more concrete ones (Kövecses 2000, p. 4).

Lakoff and Johnson's (1980) claim that metaphors shaped (or "determined") thought was predicated on the idea that metaphors were a large part of what our concepts were, thus metaphors were the lenses through which we saw the world. Metaphors shaped thought because they were believed to be the very structure that supported our thoughts about abstract issues:

> Since much of our social reality is understood in metaphorical terms, and since our conception of the physical world is partly metaphorical, metaphor plays a very significant role in *determining* what is real for us (Lakoff & Johnson 1980 p. 147 italics ours).

This idea is also mentioned by Goatly (GOATLY, 2007, p.4), even though the author later explains that he believes that language predisposes thought, not determines it:

> ... language is not some transparent medium through which we think, but that it shapes our thoughts and practices. So the conventional metaphors in the discourses of race, sex, politics, defence, economics, environment, and so on, tend to determine our ways of thinking/ consciousness and acting/practice in these social spheres.

The strong view that metaphors were almost entirely responsible for our abstract concepts has been extensively criticized (BUNDGAARD, 2019; BUNDGAARD, 2009; MURPHY, 1996; SAUCIUC, 2009). Today, research in abstract and concrete concepts abound, and we know that these concepts comprise much other rich knowledge beyond metaphors

[26] The definitions of metaphors changed with time (see Lakoff 2008; Gibbs 2017).

(BORGHI *et al.*, 2018; DAVIS; ALTMANN; YEE, 2019; DESAI; REILLY; VAN DAM, 2018; SIMAN; FIGUEIREDO, 2021). Moreover, the idea that metaphors shape thought is often speculative and biased by the author's own ideology. For example, Goatly suggests that the metaphor "I don't buy that idea" conveys a latent ideology that ideas are things that we can buy according to their needs and desires. A different analysis would suggest that people use this metaphor because they have gone through the experience of being deceived by a salesperson who tried to make them buy a useless product as if it was good, thus, when they see that an idea seems suspicious, they may choose to not "give credit" to it, in order not to be deceived.

Metaphors probably do not determine what is real for us, although the claim that metaphors play a significant role in cognition is well supported by the empirical literature (GIBBS, 2017). Arguably the most important claims in Lakoff and Johnson's theory are: (i) that our embodied experiences bias the way we understand some aspects of abstract (and concrete) experiences (e.g. part of our understanding of TIME recruits the conceptual metaphor TIME IS A MOVING ENTITY) (GENTNER; IMAI; BORODITSKY, 2002); (ii) some metaphors are systematically related (e.g. "She **attacked** my argument", "I **defended** my argument); (iii) metaphors are not merely rhetoric or poetic figures; they are a cognitive phenomenon that may affect reasoning.

According to Conceptual Metaphor Theory (Lakoff & Johnson 1980), conceptual metaphors were expected to shape thought because they were fixed and determinant systems. Today, some authors endorse the claim that: "Conceptual metaphors should probably be seen as cognitive tendencies, rather than systematic and coherent structures that fully govern the semantics of a group of lexical items" (GIBBS, 2017; SVANLUND, 2007). Variations in the construct of conceptual metaphors are also emphasized:

> The generality at which implicit metaphors can be identified, and the family of metaphors to which a particular expression belongs, may therefore be indeterminate. Different individuals may interpret the same expression according to different implicit metaphors and derive different entailment. This possibility does not imply that conceptual metaphor theory (CMT) is circular or untestable. Nonetheless, there may not always be singular correspondences between specific verbal metaphors and particular underlying conceptual metaphors" (GIBBS, 2017, p. 115).

Another influential idea is that metaphoric framing (LAKOFF, 2014) - which is the choice of metaphor in the ongoing discourse, as opposed to fixed metaphors in the mind - can significatively and unconsciously shape people's thoughts, affecting, among other domains of experience, the course of politics. Both conventional and novel metaphors are expected to influence how people reason about political issues (i.e., the scope of analysis is not merely the "metaphors we live by", which are ingrained in our thoughts and cultures, but all metaphors). In *Don't think of an Elephant,* Lakoff (2014) suggested that a metaphor used by right-wing politicians, such as "Tax Relief", could sway public opinion. The reasoning was that the public would make the inference that anyone who advocates for taxes is evil, and those who propose to decrease taxes are heroes, for unloading the "burden" of taxes from the taxpayer (i.e., "tax relief"). Lakoff goes as far as to suggest that the left-wing politicians should reframe the debate and use an alternative metaphor: taxes are membership fees, which we must pay to use the amenities of our country, such as good roads, and public space, etc.

Pinker (2006), among others, has criticized Lakoff's claims:

> The upshot is that people can evaluate their metaphors. In everyday conversation they can call attention to them, such as the deconstruction of the "time is space" metaphor in the African American snap "Your mama's so dumb, she put a ruler on the side of the bed to see how long she slept." And in science, practitioners scrutinize and debate whether a given metaphor (heat as fluid, atom as solar system, gene as coded message) accurately captures the causal structure of the world, and if so, in which ways […] Finally, even if the intelligence of a single person can be buffeted by framing and other bounds on rationality, this does not mean that we cannot hope for something better from the fruits of many people thinking together—that is, from the collective intelligence in institutions such as history, journalism, and science, which have been explicitly designed to overcome those limitations through open debate and the testing of hypotheses with data.

There are many reasons why Lakoff's claims elicit skepticism, especially given the notable complexity and dynamism of the political and social spheres (CHOMSKY; PATEMAN, 2005) - it is difficult to see how metaphors can have an impact on the multivariate course that stretch through time leading to a political outcome. Lakoff's (2014) claim seemed to imply that the reason right-wing politicians were popular was (in significant part) explained by the fact that they used metaphors to sway public opinion, and that a change of metaphors could help left-wing politicians. Could metaphors help shape the course of politics? How do metaphors interact with previous beliefs, knowledge, and ideologies? If we consider all the factors that may interact with metaphors in the wild, would metaphor still be relevant enough? Conceptual Metaphor

Theory has never predicted anything about the conditions under which metaphors are likely to shape thought as opposed to being resisted (GIBBS.; SIMAN, 2021) or ignored. Before we offer some considerations on those questions, let us first consider some evidence that metaphors, indeed, shape thought.

## 7.3 What experiments show

There are many experiments that support Lakoff and Johnson's Conceptual Metaphor Theory (GIBBS, 2017). Experimental evidence suggests that it is plausible that (i) conceptual metaphors are part of our conceptual system, even if they do not constitute most of our abstract concepts (as we have discussed in the previous section); (ii) conceptual metaphors affect how metaphors are processed, but not always (MCGLONE, 2007, 1996; THIBODEAU; DURGIN, 2008); (iii) metaphors affect reasoning under very specific conditions (see below); and (iv) the effects of metaphors on reasoning are not exclusive to conceptual metaphors but extends to analogies in general (GENTNER; STEVENS, 2014; THIBODEAU; BORODITSKY, 2011).

The tests of how metaphors affect reasoning have some similarities. Scientists present participants with texts about a subject (e.g., crime). The texts are almost the same in every condition, except for the metaphors: each condition has a different metaphorical framing. That is, they have the same base (e.g., crime), but different vehicles (e.g., beast vs. virus). For the experiment to work, participants need to understand the implied analogy. They need to understand that when we say that "crime is a beast", we mean that the crime situation is (possibly) dangerous, out of control, aggressive, and in need of authorities to contain it. On the other hand, when we say that "crime is a virus", we emphasize (possibly) that crime is spreading from person to person, and in need of social action, conscientization, and remedy. Participants must (generally unconsciously) understand some of the implications of these analogies, as they reply to questions about the text they have just read (e.g., what recommendations would they make to stop crime). Experiments show that participants reply in a metaphor-consistent way. That is, in the "beast" condition, they tend to suggest (consistently with the metaphor) more punitive measures ("Lock up criminals"), and in the "virus" condition, they tend to suggest preventive measures ("invest in educational programs") (THIBODEAU; BORODITSKY, 2011).

Experiments with metaphoric framing effects are an effective way of showing that people can respond to metaphors by working out implicit analogies. But how well do these

findings illuminate real-world possibilities? An experiment's ecological validity might be questioned because experiments' stimuli (texts) are tailor-made to produce effects - if we add more information to the text or change information in the text or the world, we can no longer be sure how participants will behave upon encountering the same metaphors.

For instance, Hart (HART, 2017) found that metaphors shape thought, but not when participants had a conflicting source of information. In the experiment, participants read a text about a civil disorder that was framed with fire metaphors. Participants were more likely to support police use of water cannons in response to social unrest when they read a text with fire metaphors than when they read a text with the same information but no fire metaphors. However, when the same texts were presented with an image of civils that suggested their actions were not so threatening, participants were not influenced by fire metaphors. Thus, when participants were exposed to images (photos) that contradicted what the metaphor (text) suggested, the evidence suggests their thoughts were not shaped by metaphors. But is it the case that having a conflicting source of information will always win over metaphoric description? What a conflicting source of information is for every person in the ideological spectrum (regarding different subjects) might be very different in the wild, as opposed to in the lab (considering the few interacting constraints we can test in the lab).

Elmore and Luna-Lucero's (2016) research on the interaction between metaphor and beliefs/stereotypes produced some enlightening evidence. In their experiment, the authors found an interaction between metaphors about seeds or light bulbs and beliefs about the quality of women's and men's inventions. When an idea was described as a light bulb (implying suddenness and genius) and was attributed to a woman, participants rated the idea as less genius-like than when it was attributed to a man. When the same idea was described as a seed (implying long processes and effort "to grow") and was attributed to a woman, participants rated the idea as more genius-like than when it was attributed to a man. This suggests that there is an interaction between metaphors and stereotypes (or beliefs about women and men in science), since, apparently, it is believed that a woman's ideas can be genius-like if she develops them during a long period of time (seed), but not if she has a sudden insight (light bulb). On the other hand, men's ideas appeared to conform to the stereotype of genius only if they had ideas suddenly (light bulbs), but their ideas seemed unimpressive if they needed to develop over time (seed). Thus, the very same metaphor yielded opposite effects when a small change was made, in this case, the sex of the scientist to which the metaphor alludes. But is it always the case that

metaphors will interact with beliefs about genders? Or might it be the case that different metaphors have different “interactive profiles”?

Hart (HART, 2021) suggests that hyperbolic metaphors, such as calling immigrants a “plague”, are resisted by participants, who do not find the metaphors appropriate. But are they resisting the metaphor out of moral obligation? Could these metaphors impact their thinking under other conditions that were not met by the experiment? For example, the same experiment (in which participants either read a text that compares immigrants with a plague or a text with no such a metaphor) could be followed up by a question related to how much money participants think the government should allocate to help immigrants. If participants who were exposed to “plague” metaphors suggested spending less money with immigrants than participants in the control condition, we would be capturing a metaphoric framing effect that is more subtle. The psychological literature is full of examples of the discrepancy between what people consciously say, and what they unconsciously do (GIBBS; SIMAN, 2021). We might expect that metaphoric effect is essentially the process of how metaphors scaffold reasoning, but metaphors have other dimensions, like valence, that can bias thought independently of structural effects.

Experiments are different in several ways. Some studies about metaphoric framing effects use texts and images (reinforcing the metaphors, for instance), others use only texts; metaphors are of different types (conventional, novel, etc.) in different experiments; metaphors are displayed in different positions in the text and different numbers. Sometimes it is rather unclear if all metaphors in an experiment are equally contributing to the effect or if there are specific metaphors that are responsible for the effect. For instance, in Hauser and Schwarz’s (2015) experiment, it is possible that the metaphor in the question alone is the key metaphor for producing the effect; the other metaphors in the text are less relevant. In short, experiments create optimal conditions for metaphors to shape thought, and there is no evidence that the effects they produced would be produced under modified experiments, much less in the wild, where we have conflicting sources of information and real consequences to consider.

Paying attention to these issues can help us develop a better sense of how situations build up around metaphors to create an effect. We must realize what conclusions we can derive from experiments (and from theories) if we want to effectively interfere with metaphor use in society (i.e., recommend the use of one metaphor over the other - (HAUSER; SCHWARZ, 2015)). There are still many questions we can ask regarding what metaphors may shape whose thoughts about what issues and under what circumstances. In this section, we have emphasized

that there can be no deterministic generalization about metaphors, because metaphoric effect and meaning are subjected to the interactive context in which they emerge.

## 7.4 A model for reasoning

In sections 2 and 3, we mentioned that the claim that metaphors shape thought is controversial and has had different scopes and meanings, from the original theory (e.g., LAKOFF; JOHNSON, 1980) - where metaphors were believed to determine thought - to the experimental literature (FLUSBERG; MATLOCK; THIBODEAU, 2018; THIBODEAU; BORODITSKY, 2011) - where metaphors bias thought, in specific conditions. Again, interactions are key. The role of metaphor in shaping reasoning would be especially controversial if authors were claiming that metaphors, as a fixed entity, had a determinant role in shaping people's reasoning. But recently the claim put forward is more consistent with the idea of a dynamic system (THIBODEAU.; MATLOCK; FLUSBERG, 2019). From the dynamic systems perspective, metaphors play a probabilistic role in reasoning (GIBBS, 2017; 2019), which means that depending on contextual variables, metaphors may have either a strong effect, a small one, or no significant effect. Experiments must continue to explore what variables are relevant and in what contexts.

Currently, we have no models to account for the different interactive factors that constrain our metaphoric reasoning. To make progress in this direction, this section presents two ways to envision a model for metaphoric framing effects. Both models are supposed to account for the probabilistic and interactive nature of reasoning. Computational models help us focus on fine-grained cognitive phenomena. Complex systems models help us focus on how behavior is, in fact, constrained by different factors in different timescales. It is important to realize that no model is complete.

Kruglansky et al. (KRUGLANSKI *et al.*, 2007, p. 272) use the notion of "judgmental parameter" to propose a judgment model with several variables intersecting at some of their values in each judgmental instance. Their model can deal with different parameters that could influence or bias reasoning, and that are weighted contextually and individually:

> As presently conceived, the judgmental parameters constitute quantitative continua whose specific values are determined by diverse factors: A given informational stimulus may afford a strong inference because its perceived relevance was innately ‘‘wired into’’ the human perceptual system, because such relevance was learned over repeated experience (Neal et al., 2006), or because it was derived from highly regarded ‘‘epistemic authority’’ (Kruglanskiet al., 2005), and so on. Similarly, task demands could be multiply determined by informational complexity, signal to noise ratio, ordinal position, or perceptual modality. Cognitive capacity could be determined by rule accessibility, in turn affected by the recency or frequency of its activation (Higgins, 1996), and/or by cognitive capacity determined by cognitive load, fatigue, and depletion occasioned by prior pursuits (Baumeister et al., 2000). Motivation could be determined by expectancies and values attached to a variety of judgmental outcomes and processes, for example to the cognitive activity itself (Cacioppo & Petty,1982), to cognitive closure (Kruglanski, 2004; Kruglanski & Webster,1996), accuracy (Funder, 1987; Kruglanski, 1989), accountability (Tetlock,1985), impression management (Chaiken et al., 1989), ego enhancement (Kunda, 1990), and so on.

Kruglansky et al. (2007) also assume that judgmental parameters are orthogonal and that their values derive from largely independent determinants. This means that the subjective-relevance of information may derive from a prior forging of conditional IF-THEN links between informational categories. Also, the authors explain that the magnitude of processing motivation may derive from various goals that persons might have; task demands may depend on the nature of the problem posed; and the stimulus context and cognitive resources may depend on rule accessibility and cognitive business, all representing very different concerns. This is a model that highlights that judgments are multivariate and context-sensitive. Besides, we would like to add that values are not fixed but change in relation to one another in context. This is what allows humans to exhibit rich kinds of behaviors.

Taking this parametric system to understand experiments on metaphors, we suggest that what experiments do is an attempt to downplay (or weigh down) all the competing variables that could enter participant’s judgments configurations, so that what will stand out is the metaphor. Thus, it is never the case that experiments find that metaphors shape thought in a given portion of the population about some subject - it is rather the case that metaphors offer analogical implications, that will be derived in some contexts (if participants have the proper semantic knowledge) and used by people unless some other variable interferes with it. What counts as an interfering variable depends on the context, what participants think they are doing, their beliefs, other sources of knowledge, etc.

Moreover, success in identifying an important variable does not mean this variable is always relevant. Findings can be counteracted provided the right conditions are met. For instance, Thibodeau and Boroditsky (2011) found that metaphors influence reasoning when they are at the beginning of a text, but not at the end. But Robins and Mayers (ROBINS; MAYER, 2000, study 3) found that metaphors at the end of the text work just fine. It seems that the difference between the two studies lies in the function of metaphors. In the first case, the metaphor at the end of the text had a wrap-up function, perhaps, it was not perceived as an argument. In the second case, the metaphor at the end of the text was a character's reply, which counted as central information for the activity proposed in the experiment.

In short, we are arguing that people can infer cross-domain mappings, especially during off-line judgment tasks - which is not the same as saying that cross-domain mappings and inferences are realized every time one reads a metaphor (MCGLONE, 1996; MILLER; RANEY; DEMOS, 2020; STEEN, 2017). Moreover, metaphors may influence reasoning, but under very specific conditions, experiments do not reflect the full range of dynamics that metaphors exhibit as part of our daily lives. Metaphors shape thought, but not just any metaphor, and not in just any context.

This understanding is implied by some scholars, but it is not often discussed. Thibodeau et al. (2017, p.860) state that:

> One important consideration in attempting to quantify the influence of metaphor on reasoning is the laboratory environment, which may artificially constrain (or inflate) such estimates. [...] Experiments are often designed to answer specific questions about how metaphors influence language processing, memory, or inference; as a result, they are carefully constructed to, for example, minimally instantiate the metaphor. In the real world, metaphors are often extended and supported in ways that might make them more (or less) influential. Future work may seek to establish a more ecologically valid way of estimating the effect of metaphor by using more realistic stimuli.

The problem here is what is a more realistic stimulus if the world is dynamically changing and if the information people receive from the world is dynamically changing? Experiments can show the plausibility of the claim that metaphors shape thought, but to account

for every unuttered metaphor in every context in the world is beyond what we can do at this point.

It is important to contrast what experiments show with any categorical or deterministic claims about metaphors. It is also important to acknowledge this discussion in the face of claims that stand out as carrying a different message, such as: “Metaphoric thinking exerts a significant and far-reaching influence on consumer thought and behavior” (LANDAU; ZHONG; SWANSON, 2017, p.54), or

> We find that exposure to even a single metaphor can induce substantial differences in opinion about how to solve social problems: differences that are larger, for example, than pre-existing differences in opinion between Democrats and Republicans (THIBODEAU; BORODITSKY, 2011, p.1).

With these excerpts, we point out a discrepancy, on the one hand, in how we frame the importance of metaphors and findings, which seems to imply that framing effects are quite significant for society (instead of being significant under experimental conditions), and, on the other hand, what experiments suggest, which is a dynamic, multivariate phenomenon (relationships with society are not so clear yet). When excerpts like these are added to the classic background about conceptual metaphors, they imply that we must stop using one metaphor or another, or that we can solve social problems by changing metaphors (see discussion in the next section). We need to reach a more complex understanding of metaphor’s role in reasoning.

The first model we have introduced is based on the classic (computational) sciences. We hoped that by presenting it, scholars may start to consider how the interplay of factors can be accounted for in our theorizing about metaphoric framing effects.

Let us consider now how to model metaphoric framing effects using a background in the complex systems science. This model would have to contemplate multiple timescales that affect reasoning, as people’s judgments are self-organized in real-time. Every behavior is caused by multiple factors that extend from evolutionary time to development, to what has just happened in the context people are in, to the experiences they had days earlier, etc. A real explanation involves considering all the interdisciplinary knowledge we have about the phenomena we study. As Sapolsky (2017, p. 18) says:

> […] it is impossible to conclude that a behavior is caused by a gene, a hormone, a childhood trauma, because the second you invoke one type of explanation, you are de facto invoking them all. No buckets. A "neurobiological" or "genetic" or "developmental" explanation for a behavior is just shorthand, an expository convenience for temporarily approaching the whole multifactorial arc from a particular perspective.

We can extend Sapolsky argument to say that every time one is evoking a "linguistic", or a "psychological" or a "cultural" or a "social" or a "evolutive" explanation for any cognitive phenomenon, they are de facto invoking everything at once – there is no separation and no precedence of one type of explanation over the other. In this sense, every time one reads a metaphor, the type of behavior that they engage in (e.g., thinking or making decisions that may be affected or not by the metaphor), is the result of the self-organization of multiple probabilistic and mostly non-deterministic factors. Discussing all these factors are beyond the goal of this paper (but see GIBBS; SANTA CRUZ, 2012; GIBBS, 2013).

In fact, as Gibbs (2017, p. 15) points out: "...conceptual metaphors may be emergent products of multiple, nested factors (i.e., biological, historical, cultural, social, cognitive, and linguistic), and may interact with many knowledge sources and experiences to create context-sensitive, task-specific metaphoric behavior". Not only does conceptual metaphor emerge from multiple factors, but so does reasoning.

The point of complex systems thinking is that we are dealing with phenomena that is much more complex than our minds or computers can adequately model. Thus, we end up making choices regarding what goes in and out of our models. A complex systems model, in contrast with classic models, would have to be holistic, specifying how behavior (e.g., metaphoric framing effects) can emerge from the interaction of factors that are embodied, contextual, social, biological, evolutionary, etc. Not being able to account for the entire model, choices are made to accomplish useful goals (cf. SMALDINO, 2017), for example, gaining insight on how to best approach a complex social phenomenon.

## 7.5 Metaphoric reasoning in the wild

Metaphors in the wild are somewhat different from metaphors in experiments. For one thing, metaphors in the wild are not followed up by a question or a need to make judgment. Moreover, metaphors in the wild may involve many different variables that are not present in the experiments and that might render metaphors ineffective.

It is important to make clear what we mean when making a contrast between the laboratory and the wild – or society written large. There are experiments on some topics that are very suitable to real-life situations, meaning that what happens in the wild is not so different from what happens in the lab (e.g., GIBBS.; VAN ORDEN, 2012). But this is by no means always the case (e.g., SMITH et al., 1999). When we talk about metaphors in the wild, we have to acknowledge that (i) people are exposed not to one metaphor in a text (e.g., a War metaphor in a Newspaper), but to many metaphors (e.g., Journey, Fire, etc. metaphors in different texts); (ii) different events may unfold from the time a person reads a metaphor to the time she makes a judgment; (iii) external factors might interfere with the judgment (e.g., even if a person was influenced by the metaphor, she might discuss the subject with someone else, or engage in other activities that might counteract the metaphoric effect), (iv) (most) people might not always read metaphors for interpretation in the wild, but merely skin through, etc. These points are important insofar as we want to establish what role metaphors may play in shaping the course of an event (e.g., a candidate winning the elections).

At this point, there is no clear understanding of how metaphors operate in society. There is no way of predicting how society (or anybody) will respond to metaphors. To begin to understand this problem, we might have to consider the many timescales and dimensions of meaning a metaphor may have. Some of them are:

(i) The timescale of interactions: at this timescale, a person either produces or comprehends a metaphor. Situated in a task, the listener may either fully process a metaphor (i.e., interpretation) or not (in the last case, no effect is supposed to arise). The speaker may also produce a metaphor that they choose to commit to (i.e., seeing the situation X as if it were Y), but in any case, as situations can change with time, so can the speaker's commitment to the metaphor.

(ii) Larger timescales (cultural, historical, etc.): At larger timescales, a metaphor can be recurrent and culturally entrenched, so it may have the effect of being strongly and readily

available and have cultural significance. This is what happens with War metaphors as applied to diseases. War metaphors seem more appealing, emotionally engaging, and useful to describe diseases than intellectually crafted alternative proposals (SABUCEDO; ALZATE; HUR, 2020; SEMINO, 2021). This commentary, we must insist, is not deterministic, but is meant to suggest that as much as novel metaphor may be semantically appealing, conventional metaphor has a history with multiple dimensions of psycho-social significance. And they are always there at "cognitive reach".

(iii) From shorter to longer timescales: Novel metaphors might be used once, by a few people, during a short time. Or they might be used frequently, by many, and enter our cultural shared background of metaphors, or our semantic memories (cf. BOWDLE; GENTNER, 2005). What makes a metaphor enter our collective cultural backgrounds? Here is what the answer is not: sheer repetition (PINKER, 2006). If society is a self-organized system, asking people to stop using a metaphor that they are biased to use and change it for a random metaphor, does not seem to be the best option as well (not that language and conceptual change cannot happen by overt agreement, but most of the time, change does not take place by following a central command) – but then again, this is not deterministic (since even the mere fact of proposing a change is contextual and interact with many factors). A reasonable answer is that novel metaphors that enter the cultural system are those which capture people's worldview and values. What we mean is that one does not need to persuade people to say that "Alzheimer's disease is a tragedy" – the analogy is trivial for anybody who shares the values of western society. However, one would encounter obstacles in persuading people that Alzheimer's is not a tragedy, but a "teacher who teaches us that forgetting is a part of life". Novel metaphors that capture hegemonic experiences prevail. If this is so, what we need is not a change of metaphors, but a change of society, so that our collective experiences can change enough to accommodate a different types of novel metaphors.

Do not change the metaphors, change the (social) system is an argument consistent with complex systems science (FISHER, 2017, p.27):

> Planned economies have a dismal record. Attempts to alter ecological systems for our own benefit have sometimes proved disastrous, as when the Hawaiian cane toad was introduced into Australia in an attempt to control the destructive cane beetle, only to prove itself to be the much more destructive agent itself. Attempts to set up planned utopian societies have almost inevitably ended in failure. If we can't easily foresee the consequences of our actions in complex situations, should we not simply leave the

> situation alone and watch what develops? The argument, cast in mathematical form by Wolfram (1984), has a beguiling appeal, especially if it appears that any action we take has an equal chance of improving the situation or making it worse, and that there is nothing else that we can do. But often there is something else that we can do, in principle at least. We can change the system.

At the beginning of this paper, we introduced a social problem: American society is sexist, and this is captured in the baseball metaphor used to talk about sex. Will suggesting new metaphors counteract thousands of years of culturally ingrained sexism? There are two outcomes that are more likely to happen every time we attempt to change language or metaphors: (i) nothing changes (i.e., changing the word "idiot" for "person with mental retardation" becomes a matter of fashion; prejudicial people will continue being prejudicial, and we will be forced to pick another name to label the mental condition ad-infinitum). Up to this point, of the many new metaphors suggested by scholars to reframe numerous issues, we can hardly estimate their benefit; (ii) it starts a social turmoil: that is, every time we propose linguistic changes, they become ideological disputes – because language choices, especially in the case of metaphors, are interrelated with ideological viewpoints. What is the solution then? Change the system. It is not the point of the paper to discuss how to change society, but a cognitive change would start with having more women in powerful roles (to change sexism) so that our unconscious mind picks up on different patterns.

The investigations over how metaphors shape people's thoughts are in their infancy and many questions remain to be answered. To this point, no study has been able to clarify how metaphors could have impacted an actual societal problem. When we consider how metaphor might be shaping people's thoughts in society, it is important to notice that even if everything seems to point to a metaphoric influence, a question would remain. Has the metaphor influenced people (e.g., people who were undecided about a subject), or were the people who were already thus inclined only further supported by the metaphor?

## 7.6 Conclusions

In this paper, we discussed how Lakoff and Johnson's (1980) original claim that metaphor shaped thought because it determined the structures of abstract concepts may have contributed to some misconceptions regarding metaphoric reasoning in the wild. "Metaphors we live by" (Lakoff & Johnson 1980) is still one of the most important books on metaphors,

and it sends the message that metaphors have a stronger and deterministic power over thought, which we have argued against in this paper.

On the other hand, experiments that study both conceptual and non-conceptual metaphors reveal that metaphors are one of the forces that might shape reasoning. The metaphoric framing effect might depend on how metaphors interact with other variables in the general context. The role of metaphors in reasoning is not deterministic and may shift as contexts change. If we want to claim that experiments on metaphor and reasoning can be attributed to CMT (or read in the light of CMT), we must make clear how CMT can accommodate dynamic and nonlinear findings.

Moreover, in this paper, we briefly suggested two models that can help make sense of metaphor's probabilistic role in reasoning. We also point out that it is difficult for experiments to make claims like "metaphors work better at the beginning of the text than in the end" because there is different overlapping information that will be processed with the metaphor, which is arranged (or self-organized) contextually. For example, metaphors at the end of the text can have different textual functions: they can be wrap-up commentary (in which case they are probably not going to be used for reasoning) or they can be an important argument (in which case they should be used for reasoning). Thus, generalizations over experiments need to be taken with caution, because slight changes in the text may render the generalization problematic.

In short, metaphors are a useful instrument for reasoning, albeit arguably only in some contexts. It is one of the variables that may shape reasoning unconsciously or consciously. All things being equal, it is important to carefully select metaphors to deliver the best message to an audience. But once one uses a metaphor in speech or text, metaphors enter a very dynamic cognitive world, with many variables that change from time to time, and for different people, making it a challenging task to predict the effects of metaphors on reasoning in the wild. After all, one might need to ask: what metaphors, stated by whom, to what type of audience, read/heard under what conditions, in what supporting textual environment? – the questions go on, as do the empirical investigations that are meant to shade light on metaphoric framing effects.

> The complexity of different variables shaping how figures of speech are interpreted may itself need to be explained and incorporated into a general theory of figurative meaning, rather than explained away to create simple empirical tests.
>
> Gibbs; Colston, 2012.

## 8. Know your metaphors: how types and tasks affect metaphor interpretation

### 8. 1 Introduction

What is in a metaphor? Potentially all that is in an abstract concept. The problem is that for a long time, conceptual metaphor theory (CMT) assumed abstract concepts were poor in content (LAKOFF; JOHNSON, 1980; KOVECSES, 2000; GALLESE; LAKOFF, 2005). Thus, abstract concepts would receive their structure from metaphors – they were mostly metaphorical. But that turned out to be wrong. Abstract concepts are very rich (DESAI et al., 2018; BORGHI et al., 2018; DAVIS et al., 2020). Then, again what is the content or the meaning of a metaphor?

The meaning of metaphors is established in context and may include as much information as the task required. The information can be of different nature, including schemas, cross-domain mappings, semantic attributes, structural analogies, and more. To make that case and to know our metaphors better, in this study, we ask participants to (i) substitute a metaphor word for a word similar in meaning and (ii) to explain the analogy behind the metaphors. Participants were exposed to three types of metaphors. Primary metaphors (e.g., The price of the meat is **high**), complex conceptual metaphors (e.g., life is a **journey**), and attributive metaphors (e.g., John is a **lion**). This is a qualitative descriptive study; we are not interested in hypothesis testing. We are analyzing both consistency (what participants do more frequently) and variation (what rarely happens) in responses. The reason rare responses are important is that they are possible responses. Potentially, their frequency would increase had the context been different. Outliers are not (always) noise, as we discuss in this chapter.

The goal of this chapter is also to show that different theories (that used to be considered adversaries) contribute to our understanding of metaphors.

## 8.2 Theoretical background

Metaphors have been a disputed topic in cognitive sciences, particularly since the 1980s, when Conceptual Metaphor Theory (CMT) was proposed by Lakoff and Johnson (1980). Lakoff and Johnson's theory raised criticism and skepticism (cf. GIBBS, 2017) because it so clearly distinguished itself from previous accounts of metaphors by suggesting that metaphors were embodied, formed systems of structural systematic correspondences, and were processed automatically and unconsciously by cross-domain mappings. Lakoff and Johnson's theory contrasted with many others, like Gentner's (1982) Structure Mapping Theory (SMT), and Glucksberg's (2003) Attributive-Interactive Theory (AIT), which emphasized synchronous and disembodied aspects of online processing.

### *8.2.1 Conceptual Metaphor Theory*

Conceptual Metaphor Theory proposes metaphors are organized and processed by making use of systematic structures that comprises primary metaphors and other culturally-driven correspondences (LAKOFF, 2008). The systematic structures were proposed to account for the fact that many linguistic expressions, although different, seem to imply the same general concepts. For instance, (i) "we are at a crossroads", (ii) "our relationship isn't going anywhere", (iii) "our relationship is going in the wrong direction" all seem to imply that RELATIONSHIPS ARE JOURNEYS. This system comprises correspondences between Lovers and Travelers, Relationships and Vehicles, Difficulty and Obstacles, etc. For Lakoff and Johnson (1980), the similarities across the linguistic metaphoric expressions (i)-(iii) are not a historical accident: the authors claim that modern speakers are endowed with a conceptual system of cross-domain mappings that gets activated automatically and unconsciously when processing conceptual metaphors. Thus, metaphor is primarily a conceptual phenomenon, and secondarily a linguistic one.

Lakoff (1993, 2008) claimed that there are hundreds of systems of conceptual metaphors in the mind and that they are accessed every time one encounters a conceptual metaphor, effortlessly. Currently, there are other theories that develop the idea of conceptual metaphors in different ways. For example, Gibbs's (2017, 2019) dynamic account of metaphors proposes conceptual metaphors are used probabilistically, instead of being a fixed system of cross-domain mappings that should be fully instantiated in the mind. Ritchie (in preparation) takes the stance that conceptual metaphors are very abstract and not a fixed "code". Kovecses' (2017) multi-level approach to metaphors considers metaphors dynamic in the sense that processing

can happen at different levels of granularity. Steen (2017) considers that metaphors are processed by categorization when they are not deliberate and by analogy or cross-domain mappings (as suggested by Lakoff), only when they are deliberate (deliberate are metaphors used as a metaphor in the communication). However, none of these approaches to metaphors acknowledge what is beyond the scope of cognitive linguistics. For example, the metaphor "My relationship is a dead-end street", for cognitive linguistics, should be analyzed by schemas and cross-domain mappings. The possibility that this metaphor means "I am as frustrated in this relationship as when I hit a dead-end street" is completely ignored for two reasons: (i) it is not generic enough as to appear in most situations; (ii) "frustration" does not fit regular categories of cognitive linguistics. Thus, the scope of traditional theories in this field leaves out variety and richness in meaning.

There is evidence for the general idea of conceptual metaphors. Thibodeau and Durgin (2008) show that novel and conventional metaphors are read faster when preceded by other conceptual metaphors of the same "family"/system as opposed to when they are preceded by the same general idea (stated without metaphors). There is also evidence that conceptual metaphor affects reasoning (ELMORE; LUNA-LUCERO, 2016), biasing participants to derive metaphorically consistent conclusions. Moreover, participants prefer metaphoric consistent conclusions for a text, as opposed to metaphoric inconsistent ones (NAYAK; GIBBS, 1990). See more evidence for CMT in Gibbs (2017).

Importantly, CMT proposes that metaphors are embodied. The notion of primary metaphor has become very important for the theory. Primary metaphors are a cognitive relationship between two types of basic experience that frequently co-occur. For example, the co-occurrence of AFFECTION and WARMTH as a child is held affectionately by an adult should result in a cognitive mapping between these domains. There are hundreds of primary metaphors in mind (and some authors even propose they are innate, cf. DOLSCHEID et al., 2014). There is much evidence for primary metaphors (cf. GIBBS, 2017; LANDAU, 2016), but there are issues in establishing what is the nature of these connections. Whereas Lakoff proposed these connections were metaphoric (unidirectional cross-domain mappings), there is evidence of bidirectionality in these mappings, and some authors propose a more complex explanation for the phenomenon (IJZERMAN et al, 2018; IJZERMAN, SEMIN, 2010). Linguists (see KOVECSES, 2013) also claim these connections are metonymies because they are relationships established within one domain of experience (i.e., warmth is a feature of affection). Primary

metaphors are different from complex metaphors that usually establish connections between two distinct experiences (e.g., love and journeys). There is a difference between primary and complex metaphors which is relevant for this chapter and lies in the relative weight of different types of information that a concept comprises. Both primary and complex metaphors involve concepts that have motor, affective and other types of higher level information that we commonly refer to as scripts, models, and frames (BARSALOU, 2020; 1992). The difference is that, for primary metaphors, the expected bias should lie in the sensory-motor and affective components of meaning, and for complex metaphors, the bias should lie in other types of information (thus, we will say they are more abstract).

### *8.2.2 Attributive-Interactive Theory*

Glucksberg and colleagues (1997) explain metaphors by taking into account what metaphors look like, consistently with its prototypical grammatical structure: class inclusion statements of type X is a Y (e.g. "My lawyer is a *shark*" should be processed similarly to "Lime is a citrus fruit"). Glucksberg claimed that when we process a metaphoric sentence such as "my lawyer is a shark", we create an ad hoc category, such as "things that are cruel", that are accessed by the label "shark". Thus, shark has a dual meaning, one that evokes its literal meaning (i.e., an animal) and one that evokes its metaphoric meaning (i.e., cruel, mean, menacing). In this theory, metaphors are not analogies; they are processed by creating (when novel) or accessing (when conventional) an ad hoc category.

McGlone (1996) points out that some metaphors are not processed as analogies because when we read them, we might know nothing about the topic and still be able to interpret it. For example, when participants read "my marriage is a rollercoaster ride", they have no a priori knowledge about this particular marriage, but can still derive the meaning that the marriage might be "exciting", "difficult", etc. However, even when we know nothing about the particular marriage, we know what marriages are, we know what types of culturally shared conversations people tend to have about marriages, etc. Our minds are never a blank canvas when we talk about known concepts, like marriages. Thus, it is hardly the case that we need to transfer some unconstrained knowledge from the metaphor vehicle to the topic. The more knowledge we have about the specific marriage situation, the more specific would be our interpretation of the metaphor – but we can still interpret it if we know only general information about marriages.

In any case, Bowdle and Gentner (2005) remind us that there must be some comparison, even when metaphors are novel because the same metaphoric vehicle can share different properties with the topic. For example, “Children are snowflakes” and “Youth is a snowflake”, mean different things, i.e., “unique” and “ephemeral”.

Therefore, the metaphor’s topic and vehicles need to interact. The first suggests metaphoric categories, and the second suggested dimensions of applicability. The result would be a superordinate category in the lexicon. The notion of dimensions of applicability is similar to the notion of relevance used in the conceptual combination literature (e.g., MURPHY, 1990). This is an important theory and there is a lot of evidence that metaphors are processed in a more “superficial” fashion (superficial in comparison with the systematic correspondences expected under CMT’s perspective on metaphors). For example, when exposed to properties like “cold”, participants process novel metaphoric sentences as “Marriages are iceboxes” faster than when they are not exposed to a relevant property (GILDEA; GLUCKSBERG, 1983).

In this thesis, we consider that some of the most important contributions of Glucksberg’s and colleagues' work are:

1- To show that attributes are important in metaphor processing. CMT focuses on schemas and misses out on the myriad of ways metaphors can be processed, including focusing on attributes. In contrast, Glucksberg’s theory misses out on the schematic properties of metaphors that can be evoked in different contexts. McGlone’s (1996) study was important because it showcased that metaphors are processed in different ways and this thesis follows up on his observations.

2- To show that conventional and some novel metaphors are processed faster than other novel metaphors. Some scholars suggest this is due to the fact that some novel and conventional metaphors are processed by categorization, while other novel metaphors are processed by analogy. Even though the final verdict is not given, I propose, instead, that metaphors that are processed faster are so because their salient attributes are culturally or contextually available (i.e., this is not the same as metaphors being apt). We assume that all novel metaphors are processed by analogy, and some conventional metaphors are not processed by analogy because their continuous uses in context may make other properties of the context salient, in lieu of the analogic properties.

### *8.2.3 Structure Mapping and Analogies*

The most straightforward claim to make about metaphors is that they are analogies. There are many theories about analogies, but here we present only two important perspectives on analogies. For Gentner and Markman (1997) analogies are a syntactic process that operates with rules and principles on representations. For the authors, the process of structure mapping (analogy) is comprised of (i) alignment of relational structures (as the first procedure); (ii) relational focus (mapping between commonalities); (iii) systematicity (systematic and hierarchical correspondences are mapped). Analogies can be attributive (when attributes similar in two domains are mapped); perceptual (when perceptual similarities between two domains are mapped); or structural (when the knowledge structure between two domains is mapped).

For Gentner (1983), metaphors are distributed in a continuum from pure analogies (mappings between relational structures) to mappings between attributes. This proposal assumes that non-identical elements are put in correspondence because of the similar roles they play in knowledge structures. Thus, in "Socrates is a Midwife", Socrates and Midwives are not similar to one another except for the fact that both play a similar role in helping Students/Mothers externalize their Ideas/Babies. Gentner and Bowdle (2005) later proposed the Career of the Metaphor Theory which states that metaphors are processed as analogies when they are novel and categorization when they are conventional, all the way into being lexicalized when they are dead, i.e., when modern speakers do not recognize the metaphoric vehicle anymore. There is plenty of evidence that novel metaphors are processed differently from conventional metaphors (BOWDLE; GENTNER, 2005).

We must also add that analogy is proposed to be the core of cognition by Hofstadter (2001). They are expected to be at work very often, and the mappings are fluid or fuzzy.

### *8.2.4 Contrasting theories*

We have presented three theories of metaphor processing. CMT proposes that conceptual metaphors are embodied and make use of fixed systematic relationships (i.e., cross-domain mappings), but does not focus on attributive metaphors (e.g., "My lawyer is a shark"), cannot account for the possibility that mappings and processing strategies might vary

contextually (other theories were developed to deal with this problem, as Gibbs' 2019), and does not account for the full-blown richness of abstract concepts and their analogies.

AIT proposes metaphors are processed by categorization but cannot account for the systematicity across metaphors and embodied information. SMT brings important distinctions between similes and metaphors but also does not account for primary metaphors and the systematicity across metaphors that are semantically similar (which for CMT are associated in people's semantic memories). It is a fact that we need theories that can accommodate important findings from all theories so far. It seems clear that metaphor processing is task-dependent (i.e., one might be skimming through a text or reading for interpretation; different tasks might call for different modes of processing). Also, there are different types of information that can be recruited during processing, including sensorimotor (BARSALOU, 2020).

To have a clear sense of how theories contrast in their prediction, for a metaphor like "My job is a jail", CMT would predict that its processing would recruit conceptual metaphors such as ACHIEVING A PURPOSE IS REACHING A DESTINATION and ACTIONS ARE MOTION (cf. LAKOFF, 2008, p.27). On the other hand, AIT would predict that an attribute would be enough for processing this metaphor, such as "(things that are) restrictive" or "annoying". SMT (at least in its classic perspective) would predict an analogy: jobs keep you from enjoying your freedom as prisons keep you from enjoying your freedom.

A different way of seeing the difference between theories' predictions is that CMT would predict that participants will rely more often on conceptual metaphors from the same "family" in their responses. For instance, when talking about the meaning of "My relationship is a rollercoaster", participants would rely on other LOVE IS A JOURNEY concepts (e.g., obstacles, pathways, etc.). On the other hand, AIT would predict more attributive descriptions (e.g., scary, exciting). In our study, we consider attributes as plausibly analogical in nature, thus, we do not distinguish AIT from SMT. Also, because this is an offline study, we cannot tell weather participants are performing cross-domain mappings or retrieving meanings from memory.

### *8.2.5 McGlone's (1996) study*

The idea of exploring the differences in metaphor interpretation, as we do in this chapter, comes from McGlone's (1996) study. What was especially interesting in this study is that by asking participants to paraphrase a metaphor like "my relationship is a rollercoaster ride", McGlone found that answers were as diverse as: "has ups and downs", which is a schematic knowledge, that, in speech could co-occur with hand gestures of mounts going up and down; "is scary", which is an attribute negatively valenced; and "is exciting" which is an attribute positively valenced. More telling, there is no mention of life being a journey, having a beginning, middle, and an end, of lovers being travelers, etc. That is, there is no mention of traditional Conceptual Metaphor Theory constructs related to RELATIONSHIPS ARE JOURNEYS. However, it does have a very consistent and interesting reference to "ups and downs" which is a salient meaning to rollercoaster ride types of metaphors, e.g., an emotional rollercoaster ride. To have ups and downs means to have good and bad parts, which would be a primary metaphor. This is part of what we study in Conceptual Metaphor Theory, but not HOW we study it.

Thus, the point of running a similar study to McGlone's was not, as he did, to show that interpreting metaphors (as far as his experiments can support) are best explained by Attributive-Interactive Theory than by CMT. But to acknowledge differences in metaphor interpretation, metaphor types, and metaphoric tasks. Before going into the details of our study, it is worth summarizing McGlone's results.

McGlone asked participants to paraphrase conceptual metaphors (e.g., my relationship is a rollercoaster ride). Results show that participants use more attributes (e.g., exciting) than domain-related words (e.g., words from the domain of Journey, such as "bumping"), that is, 74% of the paraphrases did not contain CMs, against 24% that could contain CMs. The author then wondered if participants could be deliberately trying to avoid metaphors and give a literal paraphrase of the metaphors in the stimuli. So he conducted a second study in which he asked participants to paraphrase the same metaphors with other metaphors. Results show that the paraphrases were not consistent with CMT (i.e., they were not from the same domain). For example, "His lecture was a three-course meal to the mind" would be more often paraphrased as "his lecture was a goldmine" (59%) than "His lecture was bread for the starving mind" or "His lectures were nutritious" (41%), which would be more consistent with CMT. Then, the author proceeded to test if, by showing participants a paraphrase with metaphors that are

consistent and metaphors that are inconsistent with CMT, they would choose those that are consistent with CMT as better paraphrases. In fact, there is no significant preference for either type of metaphor. Lastly, McGlone (1996) gave participants a memory test, in which participants first listened to conceptual metaphors and then were given a list of words as cues to the metaphors they had listened to. Cues were either from the same domain as the metaphor or a related attribute. Attributive cues were more effective than CMs in prompting the recall of metaphors.

These results do not show that CMs are definitely not used in online processing of metaphors, in the way Lakoff suggests, that is: automatically, unconsciously, effortlessly. After all, these results all come from offline experiments. And we must consider that at least sometimes we might not have the right words to report the ideas that are in our minds, thus, the answers participants give should not be seen as a reflection of their minds. On the other hand, I do not believe that what participants report are completely and always different from what goes on in their mind. Besides, I suspect that there is no clear cut, reductive, and modular process in the mind, waiting to be captured by the right experiment (i.e., online experiment, best methodology - see also SAPOLSKY; BALT, 1996). Thus, I believe that this type of study brings an approximation of what happens in people's minds as they interpret the metaphors (just as any online study is also an approximation). No study is perfect or better than the other. Moreover, I assume that metaphor processing is non-deterministic, and to suppose, like any metaphor theory (e.g., CMT) that metaphors are ALWAYS processed in the same way, is wrong.

Paraphrases and explanations for analogies are meant to test, even if not perfectly, how often conceptual metaphors constrain meaning. By conceptual metaphors, we understand two different facets of semantic memory: (i) cross-domain mappings established from previous processing of the metaphor; (ii) semantic connections between metaphors that are semantically related. In this way, a response that is consistent with CMT may not indicate that participants are being constrained by cross-domain mappings, but by a semantic web of relations.

## 8.3 Methods

In this study, we asked participants different questions about metaphors. Although the experiment had more questions, in this chapter we focus on 30 metaphors (10 primary, 10 complex, 10 attributive). Moreover, for each metaphor, we asked participants to: 1) Substitute the metaphoric word (in bold) with another word that expresses the same meaning; and 2) Explain the analogy/motivation for that metaphor (see the appendix at the end of this paper). The contrast between questions 1 and 2 is interesting because they should highlight different theoretical strategies: question one calls for conventional lexical ways of expressing a metaphoric meaning (which could evoke more responses consistent with AIT to emerge), whereas question 2 calls for analogy or conceptual metaphors (which could evoke responses consistent with CMT and SMT to emerge).

### *8.3.1 Participants*

This study was run at the beginning of the pandemics. Only 15 participants completed the whole survey (thus, we only have demographic information of these participants). Other 29 participants left the survey incomplete. Incomplete answers mean is 6,18 (T=20 items per questionnaire, 40 items total). Participants' age means is 38 years old. Most participants had a college degree (except for two, who had finished high school). 87% were female. This research was approved by the ethics committee. Participation was voluntary and participants were recruited online using social media, by sharing a call for participation on Facebook (all volunteers above 18 were welcomed). They were allowed to interrupt their participation at any moment (incomplete questionnaires were accepted and used for analysis).

### *8.3.2 Materials*

The survey was conducted using LimeSurvey in Brazilian Portuguese. Metaphors were distributed into two questionnaires, each list consisted of 5 primary, 5 complex, 5 attributive (T= 15 metaphor per list, 30 in two lists). The questions presented were: (i) Rewrite the sentence substituting the word in bold with other word(s) with the same meaning(s); (ii) For you, what is the motivation for the use of the metaphor in this sentence or what is the analogy implied by the sentence? See examples of a metaphor and of responses for the two questions:

As an example of an item, participants saw the following metaphor:

1. A sick person is a **burden.** (Metaphors' vehicles were presented in bold to make sure participants complied with what we asked of them)

The excerpts below exemplify how participants responded to questions (i), which asked for a substitution for the word in bold, and (ii), which asked for an explanation regarding the analogy, were like the examples below show:

(i) *The sick person is a* weight/undesirable/inopportune. (This participant substituted the metaphor "burden" for the words "undesirable", "weight", etc.)

(ii) *The sick person cannot do anything, the person who watches over him is responsible for the basic care of the sick person, so, I believe that* tiredness *leads to the belief that a sick person is a burden.* (This participant explained the metaphor "burden" by writing that "the sick person cannot do anything […] tiredness leads to the belief that a sick person is a burden).

Participants were given a list of metaphoric sentences like the above that always contained a metaphor in bold. Almost all sentences were of the type X is Y (e.g., Life is a **journey**; Roberto is a **lion**), except for a couple of primary metaphors (i.e., "I am feeling **down**" and "This curriculum has **weight**"), which still keeps the metaphor at the predicative position.

### *8.3.3 Procedure*

Participants typed in their answers to the questionnaires freely. Metaphors were randomized, but not the order of the questions within metaphorical items (i.e., participants always started by answering a question about substitution, and last, about analogy).

### *8.3.4 Coding*

The data were manually coded, following the scheme below:

**Analogy:** If participants' responses presented a word that could be said to independently characterize both domains, it was coded analogy. E.g., for the metaphor "This curriculum has weight", a participant's response to question (ii) was: "The idea behind this metaphor is that something that has weight will differentiate itself, it is a differential for being stronger, heavier."

We considered it an analogy between the experience of carrying something heavy which does not go unnoticed, so it “differentiates itself”, and the experience of evaluating a good curriculum that also does not go unnoticed, as it also “differentiates itself” by being better, or “heavier”). The curriculum must not be literally heavy, of course. It is an open question if this analogy would be enough for a task-specific understanding of the metaphor, or if the primary metaphor IMPORTANCE IS WEIGHT needs to be activated. We should keep in mind that the meaning of the metaphor can be different for different speakers or in different tasks.

**Metonymy:** If participants' responses presented a word that could be said to allude to the same domain of experience, it was coded metonymy. E.g., for the metaphor “My girlfriend is hot”, a participant’s response to question (ii) was: “During sex, the body temperature rises, it motivates the analogy”. This description was coded as a metonymy because it describes the co-occurrence of having sex and having the body temperature rising.

**Complex Metaphor (CM):** If participants' responses presented a word that could be said to allude to other metaphors as predicted by Lakoff and Johnson, it was coded as CM. E.g., for the metaphor “Cancer is an Enemy”, a participant's response to question (i) was “Cancer is something to be fought”. This was coded as a complex metaphor because the response makes use of another conceptual metaphor of the same “family”, supporting CMT.

**Conceptual Metaphor from Other Domain (CMOD):** If the participant’s answer presented a word that alludes to a conceptual metaphor from a domain (or a family) other than the domain of the metaphor in the question, it was coded CMOD. E.g., for the metaphor “knowledge is light”, a participant's response to question (i) was “knowledge is a pathway” (evoking LIFE IS A JOURNEY). If CMs are constraints or biases on thought, a further question would be: why do we change CMs so easily and so often?

**Context Derived:** If participants' answers presented a word that could be said to be literal or to be derived from the context of use, not from analogies or conceptual metaphors, it was coded context derived. E.g., For the metaphor “The price of the meat is high”, a participant’s response to question (i) was “The price of the meat is expensive”. Expensive is a literal counterpart to “high”. Not all metaphors have a literal counterpart as conventional as this one, which would be found in a dictionary, but very often participants would find a word that captures the idea of the metaphor. We named this “context derived” because the word chosen by participants makes sense for anyone who understands the recurrent contexts in which the metaphor is used.

The analyzed data and other information can be found here: https://osf.io/mubex/ in Portuguese.

### *8.3.5 Methodology*

This is a qualitative and quantitative study focused on understanding the regularities and irregularities in the responses participants give to our survey. Since the goal of the study was not to falsify a hypothesis or to test a theory, we have not used any inferential statistics in our analysis. The quantitative part of the study consists in keeping track of the regularities in responses (how similar the responses are, or how often a certain type of response was given). The qualitative part of the work is focused on discussing interesting cases/responses, especially ones that are rarely discussed in the literature.

### *8.3.6 Limitations*

There are limitations to this study. Some information in the conceptual system is not clearly distinguishable as belonging to one domain and not the other. We can say that "beautiful" is a clear property that both (some) flowers and (some) women have in common, thus an analogy. We can say that "damsel" is a property that women may have but not flowers, thus this is a context-derived attribute for the metaphor "Sandy is a flower". But what about cute/soft (i.e., "fofa"): is this property a part of both the domain of flowers and women independently (thus making it an analogy)? Or is this only a property of women, thus, this is a context-derived case? And can we even decide if "fofa" was meant to be a sensation (i.e., "soft") or if it was meant to be a character evaluation (i.e., nice/cute)? For this situation, we coded as context derived, since a quick search at google did not show many cases of "flor fofa" (fofa/cute flower) for Brazilian Portuguese, so we considered that "fofa" is something we generally say about women. But this certainly is not objective. The point of this study is not to give a final and objective answer about metaphors (as this might not be possible), but to explore some analytical possibilities. And we believe that there will always be points of discontent with any supposedly "objective" classification of metaphors. Thus, the data will be made available for other scholars to code it differently if the occasion arises.

The second limitation is the classification of metaphors into three categories: primary, complex, and attributive. Metaphors can be understood in different ways, depending on people's experiences and familiarity with them. Thus, some metaphors we chose were not a good exemplars in their category. Moreover, some metaphors were ambiguous. For example, "Lucas is a rat" can mean "fearful", thus, a predicative metaphor; but it can also mean "amoral/ dirty", thus, a primary metaphor?

A third limitation is yet more interesting. In this study, we code a linguistic item (either a word or a whole text segment) as an "analogy" if this item could be used to refer independently to both domains. For instance, "active" was coded as an analogy in "Irene is a hurricane", because both people and hurricanes can be said to be active. On the other hand, "nervous" is something that we could say only about a person (if we are not going to personify the hurricane). However, if we consider that there can be patterns of information in both hurricanes and nervous people that are similar (e.g., hurricanes are "shaky"/ "not still" just like a nervous person), then, "nervous" would be a word for an underlying analogy!

We don't believe that these limitations are a problem, but an advantage to the study. We by no means intend to sell our study as "objective", with "mathematical precision". If anybody tries to sell metaphor study as objective, they are mistaken.

## 8.4 Results

In 1996, McGlone proposed to test CMT by asking participants to paraphrase conceptual metaphors. He found that only 41% of responses contained conceptual metaphors, which he interpreted as a failure for CMT. Gibbs (2011), on the other hand, suggested that 41% was a good number in favor of CMT since participants are bad at paraphrasing metaphors. In this study, we go a step further and contrast CMT and other theories, especially analogy-based theories, using as stimulus primary, complex, and attributive metaphors. With our code scheme, it is not possible to differentiate categorizations and analogies: we can identify attributes, but attributes might be analogical or categorical. Moreover, we do not consider that participants' responses reflect their lack of ability to paraphrase. We assume some paraphrases are more difficult than other, for this reason, the study does not always reflect exactly how people

processed the metaphor, nor does it reflect their lack of ability to paraphrase. In short, the study is a good approximation, even if not perfect, as no study is ever perfect.

### *8.4.1 Quantitative analyses*

First, let us consider a few characteristics of our data. We coded all valid responses, even when the same participant gave more than one response for the same item. Since participants were not forced to answer all questions, it is interesting to notice that they provided more answers to predicative metaphors (38,55%), followed by primary (34,87%), and last, complex metaphors (26,58%), which might suggest that complex metaphors are more "difficult" to explain or substitute for a similar word. At first glance, this could be interpreted as something positive for CMT: CMs are different from other metaphors. However, it is important to have in mind that CMs (or complex metaphors) are more abstract than other metaphors. Whereas attributive metaphors are generally metaphors about people's attributes (e.g., Robert is a lion), and primary metaphor is about embodied experiences (e.g., John is a cold person), complex metaphors are about abstract domains such as love, time, life (e.g., Life is a Journey), etc. which might make it difficult to explain (e.g. explaining "time is money" involves explaining "time", which is a more abstract concept). Also, we speculate that CMs happen in more variate contexts (they have more meanings than other metaphors). Moreover, frequency/familiarity was not controlled for. A complex conceptual metaphor such as "Society is a body" seemed rather difficult to elicit responses. This metaphor could be infrequent or unfamiliar to participants.

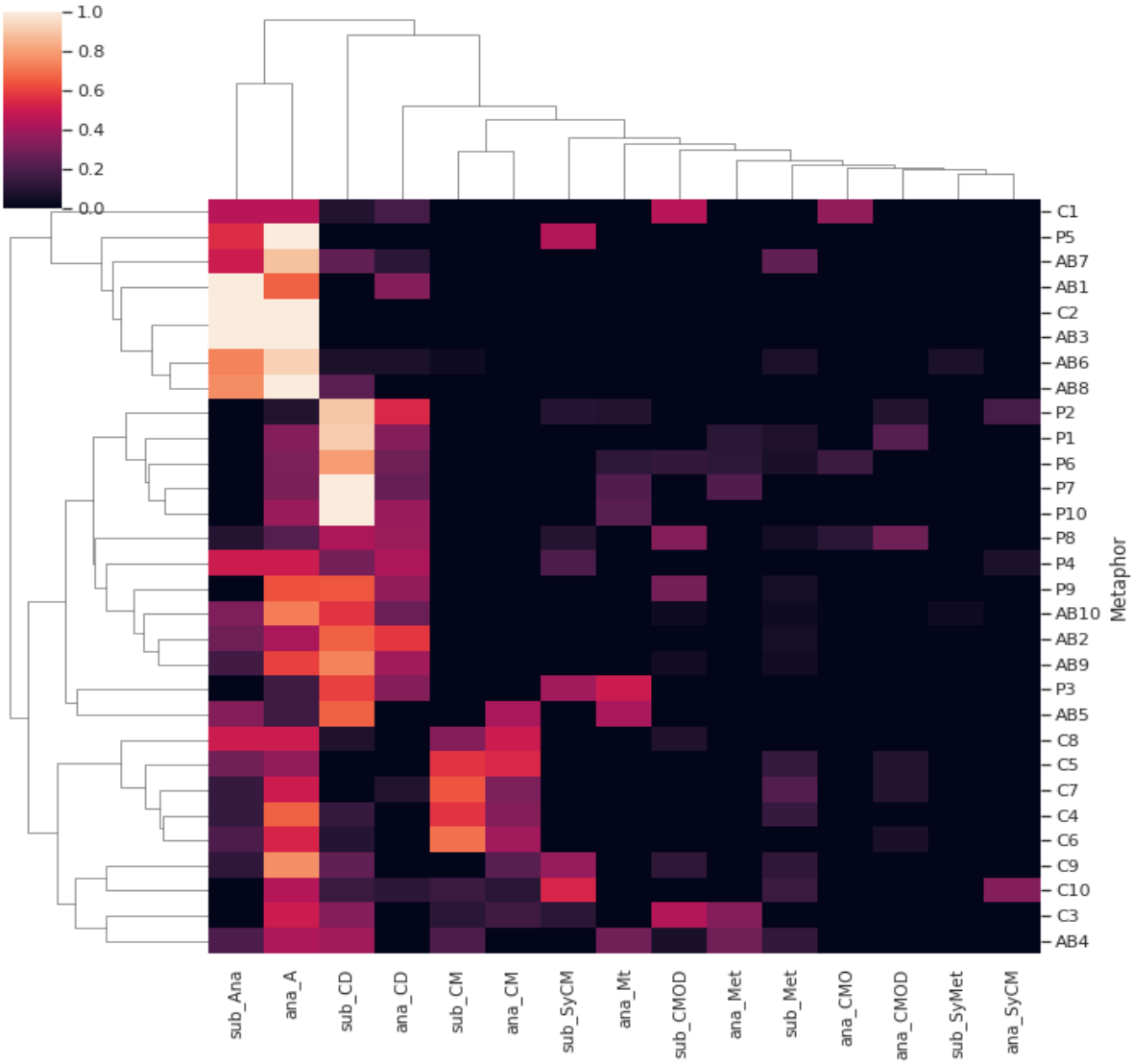
To better understand the relationships between the metaphors and strategies used to respond to question 1 and 2, we performed a cluster analysis of the dataset. Figure 9 shows a heatmap associating metaphors from the questionnaire (vertical axis) and our coding scheme of strategies (horizontal axis). Each of the 30 metaphors is labeled with its type and number (ABs are attributive; Ps are primary; Cs are complex). Our coding scheme is composed as follows: subs (substitution) refer to question 1; anas (analogies) refer to question 2. CDs are context derived; A(na) are analogies; Mt are metonymies, and so on (see methods and appendix).

The colors on the heatmap represent the total responses for each combination of metaphor and strategy. Darker colors represent fewer responses whereas lighter colors represent more responses.

To the left of the heatmap, we show a dendrogram that expresses the hierarchical clustering of the metaphors. The clustering algorithm uses single-linkage clustering to iteratively group metaphors according to the frequency of strategies in the responses (EVERITT et al., 2011). Whereas we can see our three types of metaphors generally clustering together, not all of them do. Most primary metaphors cluster in the middle of the heatmap, their main characteristics are their context-derived words in the substitution question (e.g., "expensive" for "high prices") (CD= 86 and 45, for questions 1 and 2) and they are the only group in which we found metonymies, even if in small amounts (Mt=8). They also present a fair number of analogies (A= 12 and 53, questions 1 and 2). P3 and P5 are away from their cluster: they contain higher amounts of analogies or of synonyms, and the lowest amounts of context-derived words. The fact that these metaphors did not cluster with others does not make them necessarily less of a primary metaphor; low frequency of use might explain why P3 and P5 do not have "context-derived" meanings. For instance, the metaphor P5 ("A sick person is a burden) elicited the word "weight" as a substitution, which is also a metaphor, not a context-derived (literal) word.

Complex Metaphors cluster in the bottom of the heatmap, they exhibit weaker colors in general. These metaphors rarely exhibit context-derived words. In fact, complex metaphors show many analogies and the highest concentrations of CMs (CM= 31 and 32, for questions 1 and 2), even if the total is not as expressive as other coding categories (e.g., A=24 and 56, for questions 1 and 2). Metaphors C1 and C2 are astray: they are "Our relationship is a rollercoaster", which exhibits a mix of "ups and downs" (CMOD) as responses and attributes (e.g., "unstable"); and "the society is a body", which exhibits analogies and fewer responses in general. Some complex metaphors elicited responses that matched CMT's predictions (see next section).

Figure 9- A heatmap of metaphor types and responses patterns. See appendix II for a coding scheme.




Attributive metaphors (ABs) are seen in small clusters in the heatmap. They generally had the highest rates of analogies (or categorizations) (A= 92 and 64, for questions 1 and 2, respectively), so they cluster at the top of the heatmap. Some of them are clustering in the middle, showing that some context-derived words were used, as well.

The heatmap also shows that ABs and Ps are generally closer since they elicited more context-derived and analogical responses (and more responses in general).

Regarding the difference between questions 1 and 2, we expected that question 1 would generally elicit more context-derived responses, and question 2 should emphasize analogies. This was only true, though, for primary and complex metaphors. Attributive metaphors exhibited the opposite pattern. They presented more analogies in the substitution question: this is because their substituted "analogical" content is reliably conventional. Asking participants to make the analogy explicit made them focus on analogical stories, whereas asking for a substitution elicited a straightforward attributive (analogical) response.

Lastly, for a contrast with McGlone's (1996) study which asked participants to paraphrase conceptual metaphors, we see in our study, by only looking at question 2 (which asks for an analogy), again, that 63,64% of responses to complex metaphors were analogical, and 36,36% elicited CMs. But, as we stated previously, attributive metaphors would rarely exhibit any CM as a response. Thus, even though CM must not always be interpreted by evoking other CMs, the fact that there is a significant and consistent number of responses as CMT predicts is worth noting. The same is true for primary metaphors that do exhibit large amounts of analogical explanations but are the only ones that exhibit - even if in small amounts - metonymic responses. The fact that metonymy and CMs do not rate high might have different possible explanations: the activity proposed, and the material chosen might have contributed to help elicit analogy over other types of explanations.

### *8.4.2 Qualitative analyses*

There were some variations in responses within metaphors - but not always. One striking example is THEORIES ARE BUILDINGS, for which all responses were consistent with CMT, except for one analogy (remember that complex metaphors tended to have fewer response entries as compared to other metaphors):

1. *His theory is solid*. [CM]
2. *His theory is well structured.* [CM]
3. *His theory is structured*.[CM]
4. *His theory is strong, well-formulated, well structured.* [CM] [CD] [CM]
5. *His theory is solid.* [CM]

6. *His theory is solid*. [CM]
7. *His theory is solid.* [CM]
8. *His theory is big*. [A]

Let's contrast this data with what participants answered for the conceptual metaphor "My relationship is a rollercoaster". In the answers below, there is only one conceptual metaphor consistent with RELATIONSHIPS ARE JOURNEYS ("we do not know where this is going"). Other responses presented a conceptual metaphor from another domain ("ups and downs" and "full") and other analogical attributes (e.g., "unstable"), which is consistent with what McGlone (1996) found for the same metaphor.

1. *Our relationship is intense, full of ups and downs and we do not know where this is going.* [CD] [CMOD] [CMOD] [CM]
2. *Our relationship has ups and downs.* [CMOD]
3. *Our relationship is unstable.* [A]
4. *Our relationship has ups and downs.* [CMOD]
5. *Our relationship is unstable/messy*. [A] [A]
6. *Our relationship is unpredictable.* [A]
7. *Our relationship is an up and down of emotions.* [CMOD]
8. *Our relationship is full of ups and downs.* [CMOD]
9. *Our relationship is complicated.* [CD]

Responses for attributive metaphors were attributive/analogic, as expected. For example, for "Roberto is a Lion", responses include "strong", "leader", "aggressive", and "brave". The most interesting data in this section was referent to the metaphor "My mother-in-law is a snake". Turns out that "snake", for some of the participants, is not merely the animal one would find in nature; it is also the snake from the bible. Some participants clarified that in their analogies. Thus, an attribute like "liar" would be an analogy (even though we could argue over the technicalities of what the serpent from the bible does when it persuades Eve to eat the fruit). For example:

1. *The analogy comes from the bible where a snake "deceives" Adam and Eve making them leave paradise. Besides, the fact that the animal has no members and is poisonous causes repugnance in humans, which avoids the species.*

In the excerpt above, a participant points to three possible analogies that motivate the metaphor: (i) an analogy with the serpent from the bible, which is *deceitful* like some mothers-in-law; (ii) an analogy with the animal, which is *repugnant* like some mother-in-law's behaviors; (iii) an analogy with the behavior of humans (or sons-in-law) regarding snakes (or mothers-in-law), of *avoidance*.

In this study, we also noticed that participants would often rely on metaphors from other domains as they replied to either the substitution or analogy question. For instance, the metaphor "This idea is empty" (IDEAS ARE CONTAINERS) has triggered responses like "This idea has no foundation" (IDEAS ARE BUILDINGS). This type of response has happened about half of the time for this metaphoric item. This might suggest either that people do not distinguish the "empty" and "foundation" metaphors as belonging to two different domains (i.e., the dead metaphor hypothesis), or simply that "no foundation" is a readily available term to describe bad ideas. These conflictual interpretations can be traced back to Nayak and Gibbs's (1990) findings, where the authors notice that participants do not always choose the metaphoric consistent sentences to finish a metaphorical text.

One of the most interesting findings in our study was that participants produced analogies for primary metaphors. Primary metaphors are traditionally considered mappings acquired from the frequent co-occurrence of experiences. For example, when a child is held in an adult's arms, it receives warmth and affection at the same time. This conceptual and embodied connection should license linguistic metaphors, such as "he is a warm person", "a warm hello", "a cold stare", etc. But what about our physiological responses to affective situations? Such as when we feel some parts of our body get warm as someone does something nice for us, like treat us with tenderness (e.g., our faces blush, or we sweat). Damasio (2018) claims that the brain maps our interoceptive bodies, our physiological changes, and our "feelings" (which might serve as input to analogies). This expectation about CMT is also present in Gibbs' (2006) work.

Participants' responses to primary metaphors included what we called metonymies, which were references to same domain mappings, analogical mappings based on physiological changes, and analogical mappings based on other perceptual experiences. Thus, it shows that our experiences with AFFECTION AND WARMTH (and other primary metaphors) do not end when we are a child acquiring these mappings. We continue our entire lives establishing new connections. This does not mean that these new connections are the default mode of processing, which online experiments try to uncover (if there is any): but it is a part of our knowledge about metaphors, and we might rely on it eventually. For the metaphor "John is a cold person", participants' responses included:

1. *It is associated with the fact that when we get warm we feel closer, physically and emotionally, with our feelings.* [Mt]
2. *In cold environments or the winter, people tend to be less agitated, streets have fewer people moving around, as a way for people to save the energy they have in their bodies. Thus, just like in chemistry, lower temperatures are associated with less molecule movement. A cold person is known for being a less spontaneous person, she does not share her emotions or does not feel much of the effect caused by emotions.* [A]
3. *We think of human interactions as being hot, mainly because in moments of happiness we feel our bodies get warmer, like a wave of heat. Thus, the opposite would be cold, that is, no emotion, no wave of heat.* [Mt] [A]
4. *When a body is taken by emotions, we feel hormonal injections in our bloodstream which bring the sensation of warmth in the body: sweat, agitation, etc. The coldness mentioned is related to people who are not moved by these hormonal and emotional shots and keep calm and sterile in critical or intense situations*. [A]
5. *I don't know, but I think that this is an analogy with things that are "frozen" because what is frozen does not suffer from the "elements". It remains "stagnant"*. [A]
6. *Generally, there is little life where it is cold.* [A]

From these responses, we see that participants resort to a variety of experiences to come up with analogies: LACK OF LIFE IS LACK OF EMOTION; LACK OF MOVEMENT IS LACK OF EMOTION; LACK OF RESPONSE TO WHAT HAPPENS OUTSIDE IS LACK OF EMOTION. Also, references to physiological changes are made (PHYSIOLOGICAL

CHANGE IS EMOTION): “hormonal injections in the bloodstream”, “wave of heat”. And lastly, metonymic reference also appears (e.g., “in moments of happiness we feel our bodies get warmer”). All of these look a little far from the traditional explanation that affection and warmth correlate in our childhood. However, it is important to acknowledge that we have explicitly asked for an analogical motivation, thus, participants were biased into thinking about analogies. For this reason, we are claiming that the knowledge people have or may derive from metaphors are multiple and might be used in different situations and different tasks.

We believe that analyzing the physiological associations people develop with metaphors also helps establish, as Barsalou (2020, p.6) suggests, that embodied cognition involves more than action systems:

> Embodiment is often equated with action, including motor actions, eye movements, and facial expressions [...] Many other bodily systems, however, are also central to cognition, affect, and behavior, including the autonomic system, the endocrine system, the immune system, the cardiovascular system, the respiratory system, the digestive system, and the integumentary system. Additionally, action wouldn’t be possible without the skeletomotor system. Although many of these systems may seem irrelevant to cognition, affect, and behavior, they often contribute to them significantly and in turn are affected by them.

Since the tasks in our experiment involved asking participants to provide a substitution and to explain the analogy for a given metaphoric word, one might wonder if our results reflect two (or more) processes, and that at some point participants might have processed metaphors uniformly (according to any of the theories), to only later switched to other strategies. However, there are reasons to suspect that processing is also multifactorial (BORTFELD; MCGLONE, 2001). Moreover, even if participants' responses do not reflect processing, but a secondary strategy, it would be hard to imagine how this strategy could be so completely unaffected by the supposedly homogeneous processing that had just occurred when they read the metaphors, yielding a range of different interpretations, from analogies with physiological processes and attributes to conceptual metaphors.

In fact, the view we hold about conventional metaphors is a different one: we believe that the metaphors have a constellation of information acquired through different uses; the structural elements (i.e., conceptual metaphors) are very frequently secondary. The multidimensional meaning of metaphors involves information from typical instances of use, including who uses the metaphor, for what purposes, and other contextually derived knowledge.

The fact that metaphors are also organized around “gestalts” or metaphoric systems/structures is secondary and evident in some contexts/tasks and not others. One way of understanding this is by thinking about the following case of adjacent metaphors: “It was very hard to get here. But I still haven’t got anywhere”. This sentence was found in a meme, presumably pronounced by a soccer player. The sentence makes perfect sense, and could be paraphrased as: “It was hard to do all that I have done so far. But I still haven't done all that I want to do”. On the structural level (which is the level of Conceptual Metaphors), though, lies the inconsistency: if you got here, then you got somewhere, thus, “I still haven’t got anywhere” clashes with the first assertion. This conceptual clash can go unnoticed, which implies that we must not always focus on conceptual information.

This example is meant to showcase the difference between different kinds of knowledge we have about the meaning of a conventional metaphor and the structure which is the focus of Conceptual Metaphors. This rich information is rarely accounted for by theories of metaphor - especially by Lakoff, who has proposed that Conceptual Metaphors comprised most of our knowledge about abstract concepts (see BUNDGAARD, 2019).

Our viewpoint about the tasks and results of this study is that the multidimensional content, or the knowledge people have about each conventional metaphor, is distributed with different weights: for predicative metaphors, the weight in some attributes stands out clearly, making up for more consistent attributional responses. Moreover, some metaphors have a literal counterpart, which makes up for an attractor basin in responses (e.g., “The prices are high” can be rephrased as “The prices are expensive”, but not every metaphor has such a conventional literal counterpart, especially abstract CMs). CMs, being more abstract and generally lacking conventional literal counterparts, will demand different and more variable strategies to “put into words” something which is multidimensional. Thus, we will find the use of structurally similar CMs to explain the meaning of a CM not because people lack other types of knowledge, but because expressing this knowledge is something non-conventional and their level of abstraction renders the activity more challenging. We could see that participants would even use CMs from different domains as “synonyms” for other CMs. For example, “This idea is empty” [IDEAS ARE CONTAINERS] was rephrased as “This idea has no foundation” [IDEAS ARE BUILDINGS]. This happens, we propose, because the meaning of both metaphors are highly similar, and the structural component (Containers/Buildings) are secondary. Other cases of using other domain

metaphors were less consistent but include rephrasing “This curriculum has weight” [IMPORTANCE IS WEIGHT] by “This curriculum has content” [IDEAS ARE CONTAINERS].

The goal of this study was to capture some of the similarities and differences among different types of metaphors. In future work, in case one finds it necessary to have more regularity in their data, one may control for: (i) frequency, (ii) familiarity, (iii) the number of different meanings a metaphor has (e.g. “rat” can mean “coward”, making it a predicative metaphor, or it can mean “amoral” making it a conceptual metaphor), and (iv) level of abstraction of conceptual metaphors (e.g. “time is money” is more abstract than “Life is a Journey” within conceptual metaphor, which makes it more deviant).

In any case, a dynamical view of metaphors will assume that metaphor interpretation is based on many factors, such as the history of who is interpreting, the understanding task/goals, the chosen metaphors, the empirical methods used to access understanding, etc. (GIBBS, 2010; GIBBS, 2013; GIBBS; COLSTON, 2012; GIBBS, 2019).

## 8.5 Complex Systems: analyzing regularities and variabilities

Complex systems are systems “[...] in which large networks of components with no central control and simple rules of operation give rise to complex collective behavior, sophisticated information processing, and adaptation via learning or evolution” (MITCHELL, 2009, p. 4). Complex systems are self-organized (without a central control) by the interaction among multiple factors (no factor is more important than the other) in different timescales (behavior is caused by factors that range from evolutional biases to developmental, cultural, and neurological biases - among others). In this sense,

> conceptual metaphors are not static representational entities existing only at the cognitive level, but are stabilities in experience that are emergent products of the human self-organized system. Thus, each conceptual metaphoric understanding unfolds over time given the specific contingencies that define any specific discourse situation (GIBBS; SANTA-CRUZ, 2012, p. 304).

Other metaphoric behavior (apart from conceptual metaphors) can be characterized as emergent in the same way, from a combination of factors.

Sapolsky and Balt (1996, p. 194) explain that “Intrinsic to reductionism is a view about the nature of variability in data. Some variability is deemed legitimate and interesting, as it reflects as-yet-unrecognized factors in the workings of the system under study”, but “other source of variability is little more than an irritant, a problem of measurement instruments—or the humans who use them—not being sufficiently precise; i.e., the variability is simply ‘noise’ that will decrease with improved instruments.” On the other hand, for a complex systems approach, “variability is not mere noise, but is intrinsic to the component parts of the system; moreover, it is independent of the scale of observation” (SAPOLSKY; BALT, 1996, p.194).

Regarding cognition, we understand that some phenomena happen in predictive ways, they are strong attractors. Other phenomena vary more often contextually. Contrary to reductionist science, complex systems approaches do not need to ignore instabilities. Since cognitive processes result from the interaction of different factors when results are inconsistent with main theoretical approaches, they are not dismissed as “noise”, they are plausibly accounted for using our knowledge (gained from experiments or other empirical sources) of how factors may have interacted to produce that result. That is, in all experiments, even if the hypothesis is confirmed, there are often several participants that do not conform to the norm. As Gibbs (2010, p.37) says: “When faced with variable data within any experiment [...] psychologists typically explain discrepant findings away as being due to ‘error’, ‘noise’, or ‘individual differences’ without further specifying the nature of these differences”. In the same paper, Gibbs explains both the regularities he encountered in a pragmatic experiment and the irregularities, that is, about 30% of participants did not conform with the general trend. The author proceeded to explain, based on the results of other experiments, what factors may have plausibly accounted for the variation. After all, “Sex, Occupation, IQ, Social status, Language, Culture, Geographic origin, Religion, Political background/beliefs, Ethnicity, Personality, Past and present bodily experiences, Physiological differences (e.g., brain disorders, disease)” (GIBBS, 2010), etc. may all play a role in how people self-organize when performing a task.

In our study, we draw attention to regularities and irregularities in participants’ responses to the tasks of substituting a metaphoric word for another word and explaining the analogy that motivates the metaphors. The results show that participants can make use of much different knowledge when expressing the interpretation of metaphors, even for the same metaphor (attributes, analogies based on stories, analogies based on physiological experiences,

metonymies, etc.). No single theory (CMT, AIT, or SMT) predicts or incorporates this amount of variability in its scope of investigation or theorizing.

AIT was important for revealing that attributes and faster processes are relevant in some contexts for metaphor processing. CMT was important for highlighting primary metaphors, schemas that underlie metaphors (e.g., the pathway schema, the container schema, etc.), and connections between metaphors (i.e. "attack" an argument and "defend" an argument might be related in the mind of a modern speaker even if we cannot a priori know if these concepts are used to instantiate the domain of WAR, GAME, ANIMAL BEHAVIOR or none of the previous). And SMT was important for highlighting and insisting on the analogical basis of metaphors, focusing more frequently on structural analogies. There are still many questions about what mechanisms are involved in metaphor processing – there is no final answer to this question precisely because all we know about cognition is inferred. But we do know, by the diversity of the data collected in this study and many others in the literature that metaphors are affected by a great number of factors in non-deterministic ways (personality, belief systems, previous knowledge, age, psychological states, social interactions, and others we have mentioned previously.)

Complex systems science is meant to tackle the probabilistic influence of multiple factors on metaphoric behavior in context. Under this view, we see regularities as "attractors" (e.g., AFFECTION IS WARMTH, the mappings acquired by a child when it is held by its affective mother, is an attractor), instead of fixed modes of representations. By understanding the richness of our conceptual system, we see that we have other types of experience that can motivate the use of a metaphor like "John is a warm person", for example, the fact that we notice physiological changes in our bodies when we experience affection or the fact that we when we are in an affective mood we may make more movements (which generates warmth), etc. The importance of a complex system approach to metaphors is that we do not need to propose an essentialist explanation for metaphors, we need to understand how different combinations of factors, in different contexts, lead to one type of emergent meaning or another. We do not need to ignore variability as something that is "idiosyncratic" or "noise", because variability is produced (in general) by the same principles, albeit in other combinations.

## 8.6 Conclusion

In this exploratory study, we have analyzed participants' responses to 30 metaphors (10 primary, 10 complex, and 10 attributive). We were able to notice clear differences across the three types of metaphors, validating their distinctions as suggested by a pluralistic account of metaphors. Primary metaphors tend to be associated with other concepts that are roughly interchangeable very often ("high", in prices are "high" is associated with "expensive"), followed by attributive metaphors, whereas complex metaphors are rarely associated with other interchangeable concepts. This might be explained either by the fact that complex metaphors are more abstract, or their use is more diverse (i.e., contexts are more diverse) than other metaphors.

Analogical (or attributive) components were high for attributive metaphors, followed by complex, and primary metaphors. There were few metonymic references for primary metaphors; on the other hand, analogic and physiologic explanations were interesting, because it points to the fact that experiences and concepts change over time, and, apparently even primary metaphors can be enriched with experiences (cf. BARSALOU, 2020). Lastly, we looked at how often complex metaphors elicited conceptually consistent responses (as CMT predicted). We noticed that it did not happen consistently for all complex metaphors, but it did happen more frequently for complex metaphors than for other metaphors.

To sum up some of our findings: all things being equal, attributive metaphors select for attributes; primary metaphors become associated with contextual attributes and they evoke more embodied/physiological experiences; and complex metaphors are so diverse (perhaps for being used in different contexts or for being more abstract) that (more often) allows for different strategies, including those predicted by CMT.

Our findings support McGlone's study by showing that attributive interpretation is important and might be found in some contexts even for conceptual metaphors, that is: CMT does not account for the possibility that people may interpret "Life is a Journey" by simply conceptualizing it as "difficult", instead of activating cross-domain mappings between Lovers and Travelers, Relationship and Vehicle, etc. Or that "The mind is a computer", in a given context, might simply be interpreted as "fast". On the other hand, other theories of metaphor will not account for the fact that "My relationship is a rollercoaster" might indeed be processed by patterns of information that include "ups and downs" (bad and good) or that "Theory is a building" might indeed evoke conceptual associations, as "foundations", "solid", etc.

We understand that metaphor processing is task-dependent (GIBBS, 2017), thus our findings are not meant to shed light on comprehension or on how metaphoric behavior might happen in other conditions. Especially, a different set of metaphors might have yielded different results. In all cases, individual experiences should be relevant for advancing our understanding of metaphors, if we consider that our conceptual system is never fully formed, and metaphors - as analogies - can draw from it indefinitely (depending on the situational demands). Our study suggests that CMT and Analogy/Categorization-based theories are relevant, even if not sufficient, for explaining metaphors. We have also shown that, by adopting a complex system approach to cognition, we can understand stabilities and variations in behavior as resulting from a combination of different factors, instead of dismissing variation as idiosyncratic or noise.

The notion that there is an ideal, that there is an essentialist optimum, is a myth.
We are all deviating from an optimum because an optimum is
an emergent imaginary thing.
Sapolsky, 2010.

# 9. How are novel (deliberate?) conceptual metaphors interpreted? Be creative.

## 9.1 Introduction

What does a giraffe have that is long? It could be its legs, its tail, but most people will readily think it is its neck. The reason most people will come up with this answer so quickly is that they don't have to search through a whole set of possibilities (i.e., everything that a giraffe has). Their search is biased, it does not start out from a blank canvas, it starts out from a biased set of previous experiences and culturally shared knowledge about giraffes. The same is true for every task you engage with. You do not start out of a blank space; you have biases that lead you to some specific answer.

Processing metaphors is the same. You don't start out from a blank space, your previous experiences with metaphors and the task you are engaging with will bias you into thinking about some aspects of the metaphor, but not others. There are two important questions about metaphors for this chapter. One is whether conceptual metaphors constrain the meaning of metaphors. This question has been asked many times before, with mixed results (HOLYOAK; STAMENKOVIĆ, 2018) – some experiments seem to support CMT, whereas others do not. The second, most recent question, was posed by Deliberate Metaphor Theory (DMT) (STEEN, 2017), and it asks whether conceptual metaphors only constrain meaning when metaphors are deliberate (when they are novel, or when they are used as metaphors in communication).

In this set of studies, we ask how novel metaphors are processed and what happens when we ask participants to be creative in their responses.

## 9.2 Theoretical Background

Sally is a block of ice. How is this metaphor processed? Searle stated that this metaphor's meaning is arbitrary because there is no similarity between Sally and a block of ice. Conceptual Metaphor Theory (CMT), on the other hand, proposed this metaphor is motivated by the enduring and embodied mappings established during the co-occurrence of experiences

of affection and warmth. In this sense, Sally is a block of ice because she is “cold”, or not affective. Sally is a block of ice for the same reason that we also say, “Sally is cold”. But no experiment has tested whether novel metaphors, like “Sally is a block of ice, a glacier, an Alaska”, that is derivative of more conventional ones, like “Sally is cold”, are processed by access to enduring conceptual metaphors.

Novel metaphors can be of different kinds. They can be poetic and perceptual, like Sylvia Plath’s metaphor for pregnancy: “I’m a (...) melon strolling on two tendrils”. Or conceptual, like Taylor Swift’s song about love as a journey: “Grab your passport in my hand, I can make the bad boys good for a weekend”. This metaphor expands the conventional metaphor LIFE IS A JOURNEY. The question of how novel metaphors are processed has been answered in different ways by different theories.

Theories make different predictions regarding how novel metaphors are processed. For example, The Career of Metaphors (Bowdle; Gentner, 2005) proposes novel metaphors are processed as analogies whereas conventional metaphors are processed as categorization. This may be true sometimes, but not always, as we are going to see in this chapter. Deliberate Metaphor Theory (DMT) (Steen, 2017) proposes novel metaphors are deliberate, thus processed by analogy, whereas conventional metaphors are processed by lexical disambiguation. Again, this might be true in some cases, but not always. We could predict, by taking this theory into consideration, that the use of novel/deliberate metaphors will increase the chances that metaphors will be processed differently from conventional ones, for instance, by increasing the use of novel information and conceptual metaphors. But what is old and novel information in metaphor processing?

Consider the metaphor “John is an Alaska”. This is a fairly novel metaphor. But this is not any novel metaphor, ir is a special kind: one that is derivative of a conceptual metaphor like “John is cold”. Do people know this? When we process this metaphor, we do we run full search through all possible interpretations. John could be an Alaska because he is big like the country. Or because he is wild, beautiful, exciting, boring… Or do we just find the conventional meaning: John is cold.

As we have learned in the last chapter, conventional metaphors can be processed in different ways, either by the use of attributes (e.g., unstable) or schemas (e.g., has ups and downs). Unless some different information shows up in response to conventional metaphors,

we consider that participants interpret conventional metaphors with old information (e.g., “cold”, “not affective” for either “John is cold” or “John is an Alaska”). Novel information is whatever is deviant from what we expect or from what we generally see in their responses to conventional metaphors. Thus, whereas responding with “cold” for “John is an Alaska” is considered old information, responding with “big”, “exciting”, “wild”, would be new. We believe that by keeping track of old and new information we can approximate the possibility that participants are engaging in more or less automatic behavior (even though we already know that some novel metaphors can be processed just as fast as conventional ones – see Glucksberg, 2008).

Moreover, by keeping track of responses that are consistent or not with Conceptual Metaphor Theory, we can infer that, even if people are not always processing these metaphors by cross-domain mappings, at least semantic connections are important for how these metaphors are associated in memory. Thus, what happens when participants interpret novel conceptual metaphors? Are they as conservative as Conceptual Metaphor Theory proposes? Or do they take the deliberateness of the metaphor as a cue that the metaphor was intended to be processed in some way other than the conventional?

It is important to make some clarifications regarding what we consider DMT to be. It seems that the theory, as it is now, claims that conventional metaphors are all processed as lexical disambiguation and all deliberate ones are processed by analogy. This is not what we are testing here. In this thesis, we consider that conventional metaphors have different meanings in different contexts, some of them might be consistent with CMT, some of them not. Some of them might be processed by cross-domain mappings, some of them not. It all depends on the specific history of use of every metaphor in conjunction with other contextual factors.

Thus, we are interested in knowing if situations that we consider more deliberate (that possibly involve more focus on the metaphor) will lead to more responses that are consistent with CMT and responses with more novel information?

## 9.3 Experiment 1: Methods

### *9.3.1 Participants*

Sixty-two participants were recruited online on the crowdsourcing platform Prolific. All participants were native speakers of Brazilian Portuguese. 55% were females, and 45% were males. Participants' ages ranged from 19 to 47 (M = 29). Most participants are university students or graduated, except for 2 who were in high school.

### *9.3.2 Materials*

Thirty-six metaphoric sentences were used in this study (12 per condition). The first condition is constituted by conventional conceptual metaphors, like "Life is a Journey". Conventional conceptual metaphors are classically studied in Conceptual Metaphor Theory (Lakoff; Johnson, 1980). What makes them a case of "conceptual metaphors", other than being studied by Lakoff and colleagues, is that they are generative and constrained by conceptual similarity. That is, they can be grouped with other metaphors that are in the same semantic domain. The other two conditions were derived from the first one. In that sense, they are constituted by two metaphors that share with the conventional one some semantic property and the domain. For instance, "Life is a walk" and "Life is a marathon", are not only in the same domain as "Love is a journey", but it shares with it at least the following properties: all three (journey, walk, and marathon) have a "beginning, middle, and an end", "makes you tired", "may have obstacles", etc. All sentences were nominative. Thus, there were three conditions: conventional, novel 1, and novel 2. The metaphoric terms in novel 1 and novel 2 followed a progressive semantic distance from their conventional base, as indicated by Latent Semantic Analysis (LSA)[27]. For instance, "walk" (0.32) is semantically closer to "journey" than "marathon" (0.05). It is important to mention that LSA is a resource available in English, not in Brazilian Portuguese (the language of the stimuli). We suspect that there is not much of a difference across the two languages for the words involved in the experiment but if there were, it would not be a problem for the experiment (since we do not rely on these measures to make conclusions, it is a secondary measure). Also, whereas conventional metaphors are more familiar, apt, and conventional, the novel 1 and novel 2 metaphors were progressively less

27 http://lsa.colorado.edu/

familiar, apt, and conventional (measured by participant's responses in a 5-point scale). These approximate conditions were chosen to emphasize the continuity across concepts, which should be reflected in responses.

### *9.3.3 Procedure*

The metaphoric sentences were distributed in a Latin square design and presented to participants in three questionnaires (on LimeSurvey platform). The stimuli were divided into groups of four questions about the same metaphor:

(i) Rewrite the sentence above substituting the word in bold for another/others with similar meaning.

(ii) How familiar is this metaphor? (1- nothing familiar; 5- very familiar)

(Do you have a subjective feeling that you have encountered this metaphor frequently before?)

(iii) How apt is this metaphor? (1- nothing apt; 5- very apt)

(Aptness refers to how well the metaphoric word expresses a property of the metaphoric topic. For example, for "life is a journey" how well do you think "journey" expresses a property of "life"?)

(iv) How conventional is this metaphor? (1- nothing conventional; 5- very conventional)

(Conventionality is a property of the word in bold. Do you think that people use this word to express this metaphoric idea?)

The stimuli were randomized between groups questions (not within groups questions). Thus, participants always saw questions from (i) to (iv), but the metaphoric items were presented in different orders. We differentiated familiarity from conventionality because we know some metaphors are not familiar to some participants while they are conventional in a culture. For example, the metaphor "his theory is a building" may not be familiar to people outside academia, but may feel conventional (i.e., participants may have a sense that this metaphor is used in their culture). Conceptual metaphors were never mentioned in the experiments. A follow-up question was asked at the end of the experiment to make sure

participants had never studied metaphors at the university level. Participants took approximately 10 minutes to complete the survey.

### *9.3.4 Content analysis*

I have coded 12 x 62 (T= 744) metaphor substitutions (or paraphrases). I have only coded the first substituted word used by participants (ignoring other words when they provided more than one answer). In coding the data, I was interested in two separate questions. First, how much the participants used conceptual metaphors (as opposed to attributes and analogies) in paraphrasing the metaphors. Thus, my coding scheme for this question was:

(i) CM (Conceptual Metaphor): In this experiment, CMs were all paraphrases that had domain-related words and that were old. This is meant to capture the possibility that conceptual metaphors constrain participants' replies in this task. Conceptual Metaphors, in this case, are attractors, which attract/bias thought. This does not imply that conceptual metaphors are fixed cross-domain mappings, as Lakoff (2008) suggests. It implies only that the previous use of domain-related metaphors affects the probability that participants will reply in a domain consistent way - regardless of their thinking in cross-domain/analogical ways.

Examples: Life is a **journey**. → Life is a pathway/ a trip/ a trajectory.

(ii) AT (Attributive): Attributes were classified as attributive. It does not mean that the metaphor was processed by categorization. It could be analogical, or it could be pulled by an attractor/bias from previous uses. But it contrasts with CMT predictions that cross-domain (semantically consistent) schemas should be used to process metaphors.

Examples: Life is a **marathon**. → Life is difficult/ fast.

(iii) AN (Analogy): Analogies were same-domain words that were used in novel ways. Analogy can be based on or constrained by conceptual metaphors, but they reflect novel ideas that are not present in their conventional counterparts.

Examples: Life is a **marathon.** → Life is running. (Running emphasizes both an attribute like "fast" and possibly a schema like "has a beginning, middle, and end". It does not equate to anything that could be derived from the more conventional case of "Life is a journey".

It presents specific information - running is fast. Thus, in this case, we have what appears to be novel information that can be constrained by conceptual metaphors. Basically, any thought that is domain-related could be said to be motivated by a conceptual metaphor, even if it is completely original.) But in this experiment, we consider this analogical rather than a conceptual metaphor. Very few cases are ambiguous like this one.

(iv) CM-O (Conceptual Metaphors from other domains): This type of response show that conceptual metaphors (as semantic domains) really do not always constrain meaning. Sometimes, metaphors from other domains are more similar in meaning to a metaphor than their domain counterpart. However, it is important to notice that some levels of information can be independent of their domains. For example, "cancer is a wall to be overcome": we can tell that "an enemy" is something that poses a physical barrier and needs to be overcome. At a deep level, an enemy and an obstacle share some of the same properties. (This is not, of course, captured by CMT).

Example: Love is an **enemy** → Cancer is a wall to be overcome. (Both enemies - WAR- and obstacles - JOURNEY - are, after all, obstacles.)

For our statistical analyses, all that matter is whether the information is consistent (1) or not (0) with CMT (attributes and analogies were coded just for our understanding of the data).

The second part of my coding consisted in checking if the paraphrases contained novel or old information. That is, are they attracted by old information, or do they reflect novel potentials? Novel and Old were mostly related to what people replied to conventional metaphors, but also to what we judged more or less usual.

Examples: Life is a **journey** → Life is a pathway (old). Life is an eternal succession of events (novel).

The word is a bomb → "the word is powerful" (old, because it appears very often in "the word is a weapon"), but "the word is a surprise" (novel, because it does not show up in other cases).

Novel information can be constrained by CMs or not (it can be an attribute). The importance of keeping track of what seems to be novel is that Steen's theory proposed that novel metaphors are deliberate and thus should be processed by cross-domain mappings. That should produce novel modes of processing a metaphor. On the other hand, CMT makes no such

a prediction, since it considers that novel conceptual-consistent metaphors should be processed the same way as other conceptual metaphors.

## 9.4 Results

The statistical analyses were made using R (TEAM, 2020) and Tidyverse (WICKHAM *et al.*, 2019), with the support of statistics manuals (OUSHIRO, 2021; WINTER, 2019).

The hypotheses in this experiment were that (i) novel metaphors (especially novel metaphors whose vehicle is semantically more distant) would increase the number of novel information because participants would engage in more "deliberate" processing; (ii) that novel metaphors (especially novel metaphors whose vehicle is semantically more distant) would increase the number of conceptual metaphors because – again – participants would be engaging in more "deliberate" processing. At first, these hypotheses seem contradictory, how can we both expect novel information and conceptual metaphors in the "novel metaphors" conditions? The idea here is that, for CMT, conceptual metaphors are part of pre-established semantic memory. But for DMT most conventional metaphors are not processed by cross-domain mappings (they are processed by some lexical entry). So, for DMT, conceptual metaphors should increase in novel/deliberate conditions.

The average of metaphor familiarity was higher for conventional metaphor (M = 3.92, SD = 1.25) than for both levels of novel metaphors, the closest novel, or novel type 1, (M = 2.81, SD = 1. 54) and the distant novel, or novel type 2 (M = 2.31, SD = 1.42). For metaphor aptness, average was higher for conventional metaphor (M = 4.02, SD = 1.17) than for both levels of novel metaphors, type 1 (M = 3.35, SD = 1.33), and type 2 (M =2.97, SD = 1.44). The same for conventionality, averages were higher for conventional metaphor (M = 3.73, SD =1.32) than for both levels of novel metaphors, type 1 (M = 2.87, SD = 1.44), and type 2 (M =2.38, SD = 1.42). Thus, the conventional metaphors we have selected in this study are more familiar, apt, and conventional than both their (closer and distant) novel counterparts. About ⅓ of participants reported not being familiar (familiarity = 1 or 2) with metaphors such as "life is a journey" - when most people will rate this metaphor a 5 or 4. The metaphor that was most unfamiliar to participants was "His theory is a building". We did not exclude any answers, but this unfamiliarity reported by some raises the standard deviation. The reason we did not exclude them is that this deviation could be attributed to the participant not understanding the task or to the possibility that people in a culture are gradiently exposed to different metaphors - not

everyone must be equally familiar with every metaphor. As conventionality greatly overlaps with familiarity, these data will not be discussed further.

Oldness of information was coded as 0s, for old, and 1s, for novel. Using a Spearman test, we found that there is a correlation between familiarity and novelty of information ($\rho$= -0.1766014, $p<0.01$). That is, the less familiar a metaphor is, the greater the number of novel information used by participants. The same holds for aptness and novelty of information ($\rho$= -0.1667259, $p<0.01$). That is, the less apt a metaphor is, the greater the number of novel information.

### *9.3.1 Percentage of novel information*

Logistic regression was used to analyze the relationship between metaphor type and the likelihood of using novel information in the responses. Remember that we are interested in how many novels information participants produce because we see CMT and even Glucksberg theories as mostly related to biases or tendencies in using old information when processing/interpreting metaphors (which contrast with the main focus of DMT, for example). Novel information does not equate to conceptual metaphor use (this variable will be analyzed next). Metaphor type, the independent variable, is encoded as conventional metaphors (intercept), Novel metaphors type 1, and Novel metaphors type 2. The model includes as control variables the age and sex of the respondents and the measures of familiarity and aptness. Table 2 summarizes the results of the regression.

Table 2: Results of logistic regression.

| | **Novel metaphors** | | |
|---|---|---|---|
| *Predictors* | *Odds Ratios* | *Conf. Int (95%)* | *P-Value* |
| Conventional (Intercept) | 0.66 | 0.25 – 1.74 | 0.397 |
| Novel type 1 | 1.57 | 0.95 – 2.60 | 0.078 |
| Novel type 2 | 3.17 | 1.95 – 5.21 | **<0.001** |
| Age | 0.97 | 0.95 – 1.00 | **0.036** |
| Sex.M | 1.29 | 0.91 – 1.83 | 0.154 |
| Familiarity | 0.95 | 0.81 – 1.13 | 0.589 |
| Aptness | 0.86 | 0.72 – 1.02 | 0.080 |
| Observations | 744 | | |

It was found that holding all other predictor variables constant, the exposure to novel metaphor type 2 increases the odds of the use of novel information by a factor of 3.17 ($p < 0.001$). For the control variables, age showed a low negative association with the use of novel information, with an odds ratio 0.97 ($p<0.05$).

In short, novel metaphors type 2 tend to lead to more novel mappings. Furthermore, older people are less likely to produce novel mappings, but this is only statistically relevant at $p<0.1$.

Conventional metaphors (condition 1), as one would expect, have stronger attractors. That is, they tend to be interpreted by old information (84% old) - whose content is variable in how relation to conceptual and attributive information. The presence of 16% of novel information in processing highly conventional metaphors suggests that people do not always process metaphors the same way.

### *9.4.2 Percentages of conceptual metaphors*

An analysis of the content of responses show that 45,2% comprised conceptual metaphors; 31,8% comprised attributes; 12,5% were analogies; and 6,04% were conceptual metaphors from another domain (i.e., the use of conceptual metaphors from another domain to describe a metaphor testifies against CMT's domain-specific claims,"love is a fight" can be paraphrased as "love is a journey" because both involve difficulties or a beginning, a middle, and an end).

Novel metaphors whose vehicle is semantically close to the conventional metaphor (condition 2), or novel type 1, turn out to be strongly attracted to their conventional counterpart. That is, very frequently, participants' answers were a statement of the conventional metaphor from which they derivate (e.g., Life is a walk → Life is a journey). Thus, they tend to be processed by old information (80% old). Notice that the numbers start to drop in relation to condition 1 (which was 84% old). In this condition, we see an increase in the reference to conceptual metaphor - not because participants are stating other metaphors from the same domain, but most likely because they are remembering the more conventional counterpart (i.e., they know metaphors in condition 2 are related to metaphors in condition 1 even though they have not been exposed to them). Therefore, we see 71% of conceptual metaphors in this condition.

Novel metaphors whose vehicle is semantically more distant from their conventional counterpart (condition 3), or novel type 2, have weaker attractors, but their attractors (old

information) are dominant in relation to novel information. In this condition, there is 58,4% of old information, and 45.3% conceptual metaphors.

Even though the number of answers that presents a conceptual metaphor is high, it is never higher than the sum of all other types of answers - or the sum of everything which is not a conceptual metaphor. This is true for conditions 1 and 3, but not for condition 2. As we have mentioned, condition 2 presented high amounts of conceptual metaphors because participants were referring back to a conventional metaphor that they remembered (e.g., Life is a walk → Life is a journey).

Logistic regression was used to analyze the relationship between metaphor type and the likelihood of using conceptual metaphors in the responses. Metaphor type, the independent variable, is encoded as conventional metaphors (intercept), Novel metaphors type 1, and Novel metaphors type 2. The model includes as control variables the age and sex of the respondents. Table 4 summarizes the results of the regression.

Table 4 – Logistic Regression

| | **Conceptual metaphors** | | |
|---|---|---|---|
| *Predictors* | *Odds Ratios* | *Conf. Int (95%)* | *P-Value* |
| Conventional (Intercept) | 0.61 | 0.26 – 1.41 | 0.244 |
| Novel type 1 | 3.21 | 2.16 – 4.80 | **<0.001** |
| Novel type 2 | 1.78 | 1.19 – 2.66 | **0.005** |
| Age | 1.01 | 0.99 – 1.03 | 0.483 |
| Sex.M | 0.56 | 0.41 – 0.76 | **<0.001** |
| Familiarity | 1.02 | 0.88 – 1.19 | 0.759 |
| Aptness | 1.08 | 0.92 – 1.26 | 0.354 |
| Observations | 744 | | |

It was found that holding all other predictor variables constant, the exposure to novel metaphor type 1 increases the odds of using conceptual metaphors by a factor of 3.21 ($p < 0.001$). This is, as we mentioned, due to the fact that these metaphors are so close to their conventional counterparts that participants will state the conventional counterpart in their responses.

As for novel metaphor type 2, the odds of using conceptual metaphors have increased by a factor of 1.78 which was only statistically relevant at $p<0.01$.

For the control variables we found that, interestingly, males show a low positive association with conceptual metaphors, with an odds ratio of 0.55 ($p<0.001$). That is males are almost 50% less likely to use conceptual metaphors in paraphrasing metaphors.

## 9.5 Discussion

Condition one has a conventional conceptual metaphor (e.g., Life is a journey). Condition two has novel metaphors that are a slight deviation from their conventional counterpart (e.g., Life is a walk). Condition three has novel metaphors that are more semantically distant from its conventional counterpart (e.g., Life is a marathon). How do people interpret novel metaphors that are derivative from conventional conceptual metaphors? CMT would propose that the same mechanism and the same mappings would be used in their interpretation. DMT would predict that conventional metaphors are processed by (attributive) categorization and novel ones by analogy (using conceptually consistent information). In this thesis, we propose that neither theory is completely correct, but both contribute to our understanding of metaphors (like all theories do). Metaphors are processed according to how different variables interact in context.

Do novel (deliberate?) metaphors increase the chances of participants using novel information in their responses? That depends on the type of novel metaphors. Novel metaphors that are semantically more distant – our metaphors type 2 – have higher rates of novel information, and fewer conceptual metaphors in their responses. This makes sense since conceptual metaphors are mostly related to old information and pre-established mappings. Interestingly, older people tend to produce less novel information.

Do novel (deliberate) metaphors increase the number of conceptual metaphors? (Because people could be thinking more deliberately about metaphors, paying attention to the cross-domain mappings)? We only found an increase in conceptual metaphor use for our metaphors that are semantically closer to a more familiar metaphor (metaphors type 1). This increase, rather than indicating cross-domain mappings – seems to indicate that people retrieve the more familiar metaphoric counterpart. That is, when exposed to “life is a walk”, they will paraphrase it as “life is a journey”.

This is important to notice because if we had not separated metaphors by semantic closeness and had half or most of what we call “novel metaphors” comprised these metaphors,

we would have made a strong claim that all novel metaphors lead to an increase in conceptual metaphor use, or that novel metaphors are all constrained by old information. Metaphors are very different; we must have a clear sense of how to categorize them for testing.

The point of comparing these three conditions (conventional, novel type 1, novel type 2) is that, even though all these metaphors share some common properties, they are not interpreted in the exact same way by all people, nor are these properties evoked in all three conditions. That is, “life is a journey”, “life is a walk”, and “life is a marathon” all share the same schematic property of having a beginning, a middle, and an end, they all can be said to be difficult or demanding or pleasurable. But what property gets selected is a matter of contextual combinations of variables. Meaning is not “unconstrained”, that is, it is not the case that “anything goes”. For example, for “life is a journey”, most participants resort back to the meaning of “long”. Even for those who do not refer to this meaning, the difference cannot be so great that it makes language incomprehensible. One of the constraints for meaning is set by use (what this metaphor tends to mean in most contexts), another constraint is the semantic domain (as proposed implied by CMT, even though this constraint should not be understood to be a block of pre-established mappings - see Gibbs, 2017). These are attractors. But metaphors can mean something other than their usual meaning. People can employ effort to derive novel information from metaphors. They are more likely to do it for less apt metaphors. But even old metaphors can be given new meaning provided that the personal context is accounted for. Of course, it is harder to tell, from an experiment that is designed to collect general information, what are the exact conditions led participants to provide new meaning to old metaphors. But one possibility (among many others) is that recent experience with anything that is related to the source or target domain of the metaphor might have contributed to it. Or that the participant believes that the experimental task should be creative.

Metaphors are not processed in the same way by all people in every context. There are attractors (tendencies) to meaning, but there is no ideal or “normal” interpretation. We are all deviating from the optimum because the optimum does not exist.

## 9.6 Experiment 2: Methods

In experiment 2, we hypothesize that conceptual metaphors will be more likely to occur in participants' responses if they are asked to be creative. This should count as a “deliberate” condition, much closer to that of poems than to ordinary situations. We also hypothesize that

the greater the amount of conceptual metaphor, the less novelty in information, because conceptual metaphors are part of semantic memory or semantic biases. The point of this experiment was to re-run the previous experiment but ask participants “Be creative in your responses!”.

### *9.6.1 Participants*

Sixty participants were recruited online on the crowdsourcing platform Prolific. The participants substituted a metaphoric word for other words with similar meanings. All participants were native speakers of Brazilian Portuguese. 71,5% were females, 28,5% were males. Participants’ ages ranged from 19 to 58 (M = 31,5).

### *9.6.2 Materials*

The same stimulus from experiment 1.

### *9.6.3 Procedure*

The same procedure as experiment one, but with the additional request of “be creative”.

(i) Rewrite the sentence above substituting the word in bold for another/others with similar meaning. But be creative in your responses!

### *9.6.4 Content analysis*

I have coded 12 x 60 (T= 720) metaphor substitutions (or paraphrases). I have only coded the first substituted word used by participants (ignoring other words when they provided more than one answer). The same content analysis of experiment one was applied.

## 9.7 Results

Just like in the previous experiment, oldness of information was coded as 0s, for old, and 1s, for novel. Using a Spearman test, we found that there is a correlation between familiarity and oldness of information ($\rho$= -0.09803493, $p<0.01$). That is, the less familiar a metaphor is, the greater the number of novel information used by participants. The same holds for aptness and oldness of information ($\rho$= -0.04219194, $p<0.01$). That is, the less apt a metaphor is, the greater the number of novel information. We are not going to discuss familiarity and aptness any further.

### *9.7.1 Percentage of novel information*

Logistic regression was used to analyze the relationship between metaphor group (conventional metaphors/intercept, novel type 1, novel type2, conventional/creative, novel type 1/creative, novel type2/creative) and the likelihood of using novel information in the responses. The model includes as control variables the age and sex of the respondents. Table 5 summarizes the results of the logistic regression for the novelty of information.

Table 5: Results of logistic regression.

| | **Novel metaphors** | | |
|---|---|---|---|
| *Predictors* | *Odds Ratios* | *Conf. Int (95%)* | *P-Value* |
| Conventional (Intercept) | 0.26 | 0.14 – 0.50 | **<0.001** |
| Novel type 1 | 0.79 | 0.51 – 1.23 | 0.300 |
| Novel type 2 | 1.48 | 0.99 – 2.24 | 0.059 |
| Age | 1.00 | 0.99 – 1.02 | 0.697 |
| Sex.M | 0.94 | 0.64 – 1.38 | 0.767 |
| Observations | 720 | | |

It was found that holding all other predictor variables constant, conventional conceptual metaphors show a low positive association with novel information, with an odds ratio of 0.25 ($p<0.001$).

The strategies of responses were not reliable for any other condition or control variables.

*9.7.2 Percentages of conceptual metaphors*

In experiment 1, we found that, with the exception of novel metaphors type 1, conceptual metaphors numbers were never higher than 50%. When we asked participants to be creative, all numbers are higher than 50%, but this is not statistically significant. For conventional metaphors, 51% are conceptual metaphors; For novel type 1, 70% are conceptual metaphors. And for novel type 2, 57, 5% are conceptual metaphors. This is a great improvement over McGlone's (1996) results, in which conceptual metaphors' numbers were never higher than 50%.

Logistic regression was used to analyze the relationship between the metaphor group (conventional metaphors/intercept, novel type 1, novel type2) and the likelihood of using conceptual metaphors in the responses. The model includes as control variables the age and sex of the respondents. Table 6 summarizes the results of the regression.

Table 6: Logistic regression

| | **Conceptual metaphors** | | |
|---|---|---|---|
| *Predictors* | *Odds Ratios* | *Conf. Int (95%)* | *P-Value* |
| Conventional (Intercept) | 0.91 | 0.52 – 1.60 | 0.747 |
| Novel type 1 | 2.59 | 1.77 – 3.81 | **<0.001** |
| Novel type 2 | 1.26 | 0.88 – 1.81 | 0.215 |
| Age | 1.01 | 0.99 – 1.02 | 0.347 |
| Sex.M | 0.66 | 0.48 – 0.93 | **0.017** |
| Observations | 720 | | |

It was found that holding all other predictor variables constant, the exposure to novel metaphor type 1 increases the odds of the use of conceptual metaphors by a factor of 2.6 ($p < 0.001$). This is, as we mentioned, due to the fact that these metaphors are so close to their conventional counterparts that participants will state the conventional counterpart in their responses.

For the control variables, we found again that males tend to use fewer conceptual metaphors in their answers, with an odds ratio of 0.7 ($p<0.01$).

## 9.8 Discussion

In experiment 2, we asked participants to be creative in their responses. But being creative is difficult, so we doubt all participants took this instruction to the core. The point of asking them to be creative was to find out if they would think deliberately about metaphors and, as we believe DMT would predict, this would lead to more analogical thinking or more cross-domain mappings.

We could see an increase in the total number of conceptual metaphors, but this was not statistically relevant. Important results from the previous experiment were replicated. For example, males tend to use fewer conceptual metaphors, and the novel metaphors type 1 are more likely to lead to more conceptual metaphor use because people seem to be remembering its more conventional counterpart.

Could the use of fewer conceptual metaphors by males indicate that there are differences in thinking styles or is it the case that males just choose not to report on their thoughts using conceptual metaphors?

Age seems to have lost its importance in a "be creative" task, which might mean that most participants were engaging in creative thinking upon command.

We did not confirm, at least at statistical levels of significance, that being creative leads to more use of conceptual metaphor. In fact, being creative (if participants were really trying to) does not seem to lead to more analogies. Many participants were using the same type of information that was found in experiment 1.

## 9.9 Conclusions

Analyzing metaphors' paraphrases is not the same as knowing precisely what people do when they process metaphors. But paraphrasing metaphors is constrained by many factors and one of them may be the enduring conceptual metaphors in semantic memory (either as semantic connections or as cross-domain mappings). This is what we have tested with our experiments in this chapter.

Metaphor processing is not homogeneous. There is always (the possibility of) novel/creative information arising from all types of metaphors and conditions because processing a metaphor is something that happens at the dynamic intersection between multiple variables, from the characteristics of the metaphors involved in the tasks to the characteristics of the individuals, and the task. There is always the possibility of using information other than conceptual metaphors in the responses.

What is important for this thesis is that creative conditions do increase (a little) the odds of using conceptual metaphors, but other tests are needed to understand what combination of conditions will lead to statistically significant results that support CMT.

Interestingly, males tend to use fewer conceptual metaphors in their responses. This leads to new questions regarding why they behave in this way, and if the use of conceptual metaphors is correlated with holistic thinking, which is more typical of women, left-wingers, and people in the East (or if males think in the same way metaphorically but reports it differently). Questions about the sociolinguistics and psychology of conceptual metaphor use could be answered by scholars in different fields (e.g., corpus linguistics).

These experiments also highlight how important it is to have a good grasp of what metaphors you choose for an experiment. If we had not separated our stimulus into two groups of novel metaphors, we could have had very biased results that we would think are generalizable to all novel conceptual metaphors.

For Bowdle and Gentner's "The career of metaphors", novel metaphors are processed by analogy, whereas conventional metaphors are processed by categorization. Steen (2017) agrees with this position, in his account of metaphors, novel metaphors are deliberate and processed as analogy. On the other hand, Glucksberg (2008) has shown that some novel metaphors seem to be processed by categorization. Conceptual Metaphor Theory (Lakoff; Johnson, 2008) would predict that metaphors that are conceptual are processed by an already established (in memory) mechanism of cross-domain mappings, just like conventional conceptual metaphors (yielding, possibly, the same interpretation of conventional conceptual metaphors).

The first problem with all of these theories of metaphors is that they suppose metaphors are a homogenous group. But metaphors are different in different dimensions, thus these generalizations don't always hold. Metaphors are processed in different ways, in different contexts, by the interplay of many variables, like metaphor type, linguistic form, task, people's backgrounds, etc. Thus, all theories have limitations. And when asked about how metaphors are processed, we can only answer: what metaphor? And in what context?

Our experiments seem to suggest that novel metaphors that are semantically close to a conventional one can be processed by conceptual metaphors, or even by old information, by remembering other similar metaphors. This seems to support CMT, except that this conventional metaphor to which participants are referring could be processed by some attribute,

instead of conceptual metaphors. Thus, it could be the case that some novel metaphors are not processed as analogies, contrary to DMT and the “career of metaphors”. For these and many other reasons, we need a dynamic/complex systems theory of metaphors.

## 10. Conclusions

Metaphor theories are generic. They state that metaphors (in general) are processed in some general way. For example, for Conceptual Metaphor Theory (CMT), conceptual metaphors were always processed by enduring cross-domain mappings. For Deliberate Metaphor Theory (DMT), non-deliberate metaphors are processed by lexical disambiguation and deliberate ones by cross-domain mappings.

What we would like to propose with this thesis, instead, is that the way metaphors are processed depends on the metaphor, the task, the individuals, the co-text, and other contextual factors. The metaphors that we call "conceptual metaphors" are the ones that are generative, which means that they are generally semantically extended. But each of these metaphors has a history of use. We can all suppose that, as Bowdle and Gentner (2005) have proposed, novel metaphors are – generally – processed by analogy, whereas conventional metaphors are processed by categorization. But do you think the mode of processing changes magically? Or is it plausible that little by little cross-domain mappings start to be overruled by other "more stable" meanings (which here we call attractors)? In this case, could it be that some conceptual metaphor mappings are "revived" often in our uses that some of them are still processed by cross-domain mappings most of the time? This is a speculation that serves the purpose of making my case that metaphors NEED not be processed uniformly.

Also, metaphors' mappings and meanings can vary from context to context. "Cancer is a journey" can mean something around (the state space of) "fun" for the cancer patient who is saying "cancer is not a journey". And it can mean some around (the state space of) "has a beginning, a middle, and an end" in other contexts. Context is fluid and can change how metaphors are processed. Moreover, communication is non-deterministic, thus, a metaphor used by a speaker need not have the same interpretation by the listener/reader. We can also find differences in how different people interpret the same metaphor, especially if the context is weakly constraining. For example, in our experiment, some participants paraphrased "life is a journey" as "long", whereas others paraphrased it as "an adventure" or "a trajectory". Each of the meanings highlights a different state space in the high-dimensional space of "journey" or "life is a journey".

In short, metaphors' meaning can be as rich as abstract concepts are rich. Life can be a journey because it has a beginning, a middle, and an end; or because it is long; or because it is short/ will finish soon; or because it is fun; or because we choose our traveling companions; or because it has obstacles; or because it is tiring/frustrating, or because it allows for exotic experiences, or because the best part of it is trying new food, or because having someone as a

guide is helpful, etc. Meaning is contextual. We hope metaphors scholars get over the idea that they know the meaning of a metaphor and that context does not matter. Context matters (GLUCKSBERG; MCGLONE, 1999). We can only make a probabilistic analysis of metaphors' meanings. That is, we can say that a metaphor tends to be processed one way or another, but we cannot know precisely how it will be processed.

To speculate even further, we believe that processing a metaphor is like going through a landscape of attractors (SPIVEY, 2008). In this landscape, we have multiple concepts being probabilistically accessed. Thus, the meaning of a metaphor (e.g., life is a journey) could be more precisely described, for example, as 60% "long"; 20% "has a beginning, middle, and end"; 10%, etc.

Please notice that this landscape is not fixed but set by the influence of many other factors (individual, co-text, etc.).

If metaphor meaning is contextual and depends on the interactions between the individual's background and situational constraints, what can we say about scholars' attempts to predict how society will react to some publicly available metaphor? For example, many participants in our experiment paraphrased "life is a journey" as "life is long". If a newspaper uses this metaphor tomorrow, can I predict that many people will interpret it as meaning "long"? Absolutely not. This metaphor will be used in rich and varied contexts. It can potentially mean very different things from what I got in my not-so-constraining experiment.

Let's say I have an experiment in metaphoric framing effect that shows that war metaphor bias people's thought, making them reason about problems in war-related ways. Can I claim that people should stop using war metaphors? Absolutely not. War metaphors are used in a variety of ways, and some of them will not have any impact or negative impact on reasoning. The request to stop the use of some metaphors in discourse, as done by scholars today, is more a question of ideology than a question of science. There is no basis to prevent the use of a metaphor that can have multiple meanings in multiple contexts just because in some context, created in the lab, the metaphor had a specific impact on people.

CMT can be seen as offering two contributions to our understanding of how metaphors are processed (i) some conventional metaphors might as well be processed by cross-domain mappings, depending on their history of use and other contextual variables; (ii) metaphors seem to be associated in memory by semantic connections (but not only that). For example, the metaphors "journey" and "trip" seem to be highly associated, they are almost synonyms. Possibly, other journey-related metaphors are associated as well, with different strengths. But so are metaphors that are not semantically related. For example, the metaphor "robot" and

"cattle" might be associated in the minds of Brazilian speakers because both are used to refer to the same type of person in the world: Bolsonaro's supporters (one participant in our study has made this connection).

One problem that CMT misses out on is that, because some metaphors are associated at a more abstract level than that of domains, metaphors share the same property. For example: "Ideas are seeds", "life is a journey", "a theory is a building", "life is a story", "love is war" might all be associated by the fact that they have a beginning, a middle, and an end. This observation comes up from noticing that some of the same responses (in our task of metaphor paraphrasing) come up for metaphors that are from different domains. **Thus, the domain that the metaphor belongs to is not necessarily the most important information in a metaphor's meaning.** Again, we should think of a high-dimensional space, in which different clusters of information may be related. Information can be related because they belong in the same semantic domain or because they share one property in common (even without belonging to the same domain).

CMT is also a theory that states metaphors work as a gestalt. That is, the speaker knows that there is a relationship between saying "I was boiling mad" and "I exploded" as both are sequential, instead of merely semantically associated. We "attack an argument" then we "win or lose" the argument. But this is not true for all conceptual metaphors, nor this is true for the same metaphors in all contexts (since metaphors can be processed in different ways). It is possible that some gestalt organization of metaphors happens in our minds, but that seems to depend on experience, on how we use those metaphors instead of being a rule (i.e., there are no principles on this).

Thus, my claim is that whatever way we represent metaphors in the mind, whatever way they are connected, it is a matter of use, not of principles. And the ways they are connected and organized is a matter of relevance and context, thus information has different weights and is likely to show up in some contexts and not in others.

In this thesis, we propose metaphors are processed in different ways, depending on their trajectory – each metaphor has its own "career" – and on the task, co-text, and the people involved. Thus, we can talk about experiments' results as showing tendencies, but not categorical distinctions. Much depends on the metaphors chosen for the experiment, the task, etc.

In this thesis, we have found (for the first time, perhaps) that males tend to use fewer conceptual metaphors – at least in a paraphrase, at least for the metaphors that we have selected. Thus, a different question would be: is this phenomenon related to them choosing not to write

conceptual metaphors (because they deem it too poetic, perhaps), or do they think differently? If they think differently, by being more analytical, could that be the case that the very people that defend CMT are the people who are less prone to thinking analytically? And would corpus research find that males are generally less likely to use conceptual metaphors in their writings (as well as in paraphrases)? (We would suppose they are more likely to use war metaphors). These are questions for future research.

In this thesis, we have also emphasized the importance of having good criteria for how we select metaphors for a test. For one thing, not all metaphors start from the same place. As shown in chapter 8, a metaphor like “a theory is a building” seems to evoke almost 100% of responses consistent with CMT. We could ask if metaphors that have a high number of responses consistent with CMT in a paraphrasing task show the same pattern in an online task. Moreover, in chapter 9, we saw that creating a category of novel metaphors that are semantically close or semantically distant from a very familiar one makes all the difference in the patterns of responses (the first type has almost 90% of responses consistent with CMT, which seems to imply that people remember its more familiar counterpart).

Most notably, what we propose in this thesis is that metaphor processing/ interpretation is contextual, sometimes being constrained by conceptual metaphors, sometimes not. By “contextual”, we understand the dynamic relationship between multiple factors, such as: previous information in the text, characteristics of the individual (age, sex, ideology, level of education, etc.), specific characteristics of metaphors (aptitude, familiarity, syntax, semantic density), etc. Understanding metaphors as a phenomenon that happens at the dynamic intersection between several variables leads to new questions, not only about which variables affect their processing but also about what "conceptual metaphors" are, after all. Conceptual metaphors are not what Lakoff and Johnson (1980) thought they were: a deterministic system of cross-domain mappings. Conceptual metaphors are one of the types of information that a metaphor can have, one that is sometimes embodied (meaning here: sensory-motor), sometimes involve cross-domain mappings, sometimes are semantically associated, sometimes form a gestalt, but not always, not equally for all metaphors.

Deliberate metaphors are not “metaphors used as metaphors” that are thus processed by cross-domain mappings. In this thesis, deliberate metaphors are metaphors that deviate from conventional modes of processing. But this conventional mode of processing can be different for different metaphors, and the deviation does not result always in cross-domain mappings, especially not the ones proposed by CMT. Particularly if we consider it at the level of communication since communication is very much non-deterministic.

As some final thoughts on the meaning of the experiments conducted in this thesis, we would like to point out the following. As McGlone (1996) had already shown, a metaphor like "my relationship is a roller coaster ride" is very frequently paraphrased as "has ups and downs". This is not consistent with CMT as a theory of cross-**domain** mappings. If mappings had to occur at the level of domains, then we would expect responses as "has a beginning, middle, and an end" or "it is a journey". But this metaphor is related to some other metaphor that is very familiar: "an emotional roller coaster". As we know, CMT proposes that negative emotions are mapped onto "downward" orientations, and positive emotions to "upward" orientations. Thus, if we understand metaphors as analogies that can happen at any level of granularity, from basic schemas to domains and much more, participants' responses would be consistent with CMT: "emotional ups and downs". But of course, not everybody must process this metaphor the same way, and this metaphor must not be processed the same way in all contexts. So for other participants, this metaphor meant "exciting" or "unstable" (and other aspects of the experience of embarking on a roller coaster). Our abstract concepts, contrary to what CMT had claimed, are very rich, and metaphor can mean very different things, in different contexts, for different people. Conceptual metaphors are a probabilistic (rather than deterministic) constraint on meaning. But before you think that we are saying that metaphors are always processed as analogies, we have said that some metaphors are processed by contextual information. That is a metaphor like "Sandra is a flower" can (potentially) be processed as "generous, maiden", even though flowers are not generous, or donzels. Neurons that fire together wire together. In this thesis, we are also not claiming that metaphors can only be processed by cross-domain mappings if they are deliberate. Much depends on the specific trajectory of each metaphor. We are saying that we believe it is possible that some metaphors such as "life is a journey" are processed by cross-domain mappings (not necessarily at the level of domains) unconsciously if these mappings are very often useful in everyday conversations. When they are not, then, as Bowdle and Gentner (2005) have stated, other processes may take over or take precedence in most contexts.

Linguists are generally only taught CMT, and this is like being put on a horse visor. It limits what scholars can see. My journey in my Ph.D. involved studying complex systems. And even though complex systems theory, just like the theory of evolution, does not have too many rigid predictions, it helped us see more. I hope this thesis is a start in my – and other readers – new outlook on the world of metaphors.

## 11. References

AARTS, B. Conceptions of gradience in the history of linguistics. **Language Sciences**, [*S. l.*], vol. 26, no. 4, p. 343–389, 2004.

ACKERMAN, J. M.; NOCERA, C. C.; BARGH, J. A. Incidental Haptic Sensations Influence Social Judgments and Decisions. **Science (New York, N.Y.)**, [*S. l.*], vol. 328, no. 5986, p. 1712–1715, 25 Jun. 2010.

AL-AZARY, H.; GAGNÉ, C. L.; SPALDING, T. L. Flute birds and creamy skies: The metaphor interference effect in modifier–noun phrases. **Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale**, [*S. l.*], US, vol. 75, no. 2, p. 175–181, 2021.

AL-AZARY, H.; KATZ, A. N. Do metaphorical sharks bite? Simulation and abstraction in metaphor processing. **Memory & Cognition**, [*S. l.*], vol. 49, no. 3, p. 557–570, 1 Apr. 2021.

ALBANO, E. AUTO-ORGANIZAÇÃO EM PSICOLINGUÍSTICA. **Cadernos de Estudos Linguísticos**, [*S. l.*], vol. 14, p. 131–140, 1988.

ALBANO, E. EMERGINDO DA ILUSÃO REDUCIONISTA EM PSICOLINGUÍSTICA. **Cadernos de Estudos Linguísticos**, [*S. l.*], vol. 12, p. 5–14, 1987.

AYERS, S. The Application of Chaos Theory to Psychology. **Theory & Psychology**, [*S. l.*], vol. 7, no. 3, p. 373–398, Jun. 1997.

BARRÓS-LOSCERTALES, A. *et al.* Reading salt activates gustatory brain regions: fMRI evidence for semantic grounding in a novel sensory modality. **Cerebral Cortex (New York, N.Y.: 1991)**, [*S. l.*], vol. 22, no. 11, p. 2554–2563, Nov. 2012.

BARSALOU, L. W. Challenges and Opportunities for Grounding Cognition. **Journal of Cognition**, [*S. l.*], vol. 3, no. 1, p. 31, 29 Sep. 2020.

BARSALOU, L. W. Situated conceptualization: Theory and applications. **Foundations of embodied cognition: Perceptual and emotional embodiment**. New York, NY, US: Routledge/Taylor & Francis Group, 2016. p. 11–37.

BEHUNIAK, S. M. The living dead? The construction of people with Alzheimer's disease as zombies. **Ageing & Society**, [*S. l.*], vol. 31, no. 1, p. 70–92, Jan. 2011.

BERNSTEIN, M. J.; CLAYPOOL, H. M. Social Exclusion and Pain Sensitivity: Why Exclusion Sometimes Hurts and Sometimes Numbs. **Personality and Social Psychology Bulletin**, [*S. l.*], vol. 38, no. 2, p. 185–196, 1 Feb. 2012.

BLANK, G. D. Metaphors in the Lexicon. **Metaphor and Symbolic Activity**, [*S. l.*], vol. 3, no. 3, p. 21–36, 1 Sep. 1988.

BOECKX, C. What Principles and Parameters got wrong. **Linguistic Variation in the Minimalist Framework**. Oxford: Oxford University Press, 2014. Available at: https://oxford.universitypressscholarship.com/10.1093/acprof:oso/9780198702894.001.0001/acprof-9780198702894-chapter-8. Accessed on: 24 Feb. 2022.

BORGHI, A. M. *et al.* Varieties of abstract concepts: development, use and representation in the brain. **Philosophical Transactions of the Royal Society B: Biological Sciences**, [*S. l.*], vol. 373, no. 1752, p. 20170121, 5 Aug. 2018.

BORTFELD, H.; MCGLONE, M. S. The continuum of metaphor processing. **Metaphor and Symbol**, [*S. l.*], US, vol. 16, no. 1–2, p. 75–86, 2001.

BOWDLE, B. F.; GENTNER, D. The Career of Metaphor. **Psychological Review**, [*S. l.*], US, vol. 112, no. 1, p. 193–216, 2005.

BUI-WRZOSINSKA, L. Conflict as an Attractor: A Dynamical Systems Perspective on the Dynamics of Conflict. *In*: NOWAK, A.; WINKOWSKA-NOWAK, K.; BRÉE, D. (eds.). **Complex Human Dynamics: From Mind to Societies**. Understanding Complex Systems. Berlin, Heidelberg: Springer, 2013. p. 227–242. Available at: https://doi.org/10.1007/978-3-642-31436-0_13. Accessed on: 31 Jan. 2022.

BUNDGAARD, P. The structure of our concepts: A critical assessment of Conceptual Metaphor Theory as a theory of concepts. **Cognitive Semiotics**, [*S. l.*], vol. 12, 24 Apr. 2019.

BUNDGAARD, P. F. Are Cross-Domain Mappings Psychologically Deep, but Conceptually Shallow? What is Still Left to Test for Conceptual Metaphor Theory. **Cognitive Semiotics**, [*S. l.*], vol. 5, no. 1–2, p. 400–407, 1 Dec. 2009.

BURKETT, J. P.; YOUNG, L. J. The behavioral, anatomical and pharmacological parallels between social attachment, love and addiction. **Psychopharmacology**, [*S. l.*], vol. 224, no. 1, p. 1–26, 1 Nov. 2012.

CASASANTO, D.; DIJKSTRA, K. Motor action and emotional memory. **Cognition**, [*S. l.*], vol. 115, no. 1, p. 179–185, 1 Apr. 2010.

CHABRIS, C. F. *et al.* No Evidence That Experiencing Physical Warmth Promotes Interpersonal Warmth. **Social Psychology**, [*S. l.*], vol. 50, no. 2, p. 127–132, 1 Mar. 2019.

CHOMSKY, N. A Review of B. F. Skinner's Verbal Behavior. 1959. **Language**. [Journal (Paginated)]. Available at: http://cogprints.org/1148/. Accessed on: 29 Jan. 2022.

CHOMSKY, N.; PATEMAN, B. **Chomsky on anarchism**. 1st ed. Oakland, CA: AK Press, 2005.

CIENKI, A.; MÜLLER, C. **Metaphor and Gesture**. [*S. l.*]: John Benjamins Publishing, 2008.

CIPORA, K. *et al.* **A Minority pulls the sample mean: on the individual prevalence of robust group-level cognitive phenomena – the instance of the SNARC effect**. preprint. [*S. l.*]: PsyArXiv, 7 Aug. 2019. Available at: https://osf.io/bwyr3. Accessed on: 25 Oct. 2021.

DAMASIO, A. R. **The strange order of things: life, feeling, and the making of the cultures**. New York: Pantheon Books, 2018.

DAMERALL, A. W.; KELLOGG, R. T. Familiarity and Aptness in Metaphor Comprehension. **The American Journal of Psychology**, [*S. l.*], vol. 129, no. 1, p. 49–64, 2016.

DANKS, D. Safe-and-Substantive Perspectivism. **Understanding Perspectivism: Scientific Challenges and Methodological Prospects**. New York : Taylor & Francis, 2019.: Routledge, 2019. p. 127–140.

DAVIS, C.; ALTMANN, G.; YEE, E. **Situational systematicity: A role for schema in understanding the differences between abstract and concrete concepts**. [*S. l.*: *s. n.*], 2019.

DAWKINS, R. **The selfish gene**. 30th anniversary ed. Oxford ; New York: Oxford University Press, 2006.

DAYAN, D. I. *et al.* Incorporating the environmentally sentive phenotype into evolutionary thinking. **Evolutionary Causation: Biological and Philosophical Reflections**. Mass: MIT Press, 2019.

DESAI, R. H.; REILLY, M.; VAN DAM, W. The multifaceted abstract brain. **Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences**, [*S. l.*], vol. 373, no. 1752, p. 20170122, 5 Aug. 2018.

DIAS, B. G.; RESSLER, K. J. Parental olfactory experience influences behavior and neural structure in subsequent generations. **Nature Neuroscience**, [*S. l.*], vol. 17, no. 1, p. 89–96, Jan. 2014.

ELMORE, K. C.; LUNA-LUCERO, M. Light bulbs or seeds? How metaphors for ideas influence judgments about genius. **Social Psychological and Personality Science**, [*S. l.*], US, vol. 8, no. 2, p. 200–208, 2017.

FAUCONNIER, G.; TURNER, M. **The Way We Think: Conceptual Blending And The Mind's Hidden Complexities**. [*S. l.*]: Basic Books, 2008.

FERREIRA, F.; BAILEY, K. G. D.; FERRARO, V. Good-Enough Representations in Language Comprehension. **Current Directions in Psychological Science**, [*S. l.*], vol. 11, no. 1, p. 11–15, Feb. 2002.

FERREIRA, F.; YANG, Z. The Problem of Comprehension in Psycholinguistics. **Discourse Processes**, [*S. l.*], vol. 56, no. 7, p. 485–495, 3 Oct. 2019.

FIEDLER, K. The dependence of the conjunction fallacy on subtle linguistic factors. **Psychological Research**, [*S. l.*], vol. 50, no. 2, p. 123–129, 1 Sep. 1988.

FISHER, H. E. Chapter 10 - The Tyranny of Love: Love Addiction—An Anthropologist's View. *In*: ROSENBERG, K. P.; FEDER, L. C. (eds.). **Behavioral Addictions**. San Diego: Academic Press, 2014. p. 237–265. Available at: https://www.sciencedirect.com/science/article/pii/B9780124077249000100. Accessed on: 4 Feb. 2022.

FISHER, L. Society as a complex system: How can we make the best decisions for our future? **Journal and Proceedings of the Royal Society of New South Wales**, [*S. l.*], vol. 150, p. 18–30, 1 Jan. 2017.

FLUSBERG, S. J.; MATLOCK, T.; THIBODEAU, P. H. War metaphors in public discourse. **Metaphor and Symbol**, [*S. l.*], vol. 33, no. 1, p. 1–18, 2 Jan. 2018.

FODOR, J. A.; MILLER, G. A.; LANGENDOEN, D. T. **The Language of Thought: 5**. Cambridge, Mass: Harvard University Press, 1980.

FORTHMANN, B. *et al.* A New Perspective on the Multidimensionality of Divergent Thinking Tasks. **Frontiers in Psychology**, [*S. l.*], vol. 10, p. 985, 2019.

FUENTES, M. A.; MIGUEL, H. Paisajes dinámicos en la modelización de la comunicación y el aprendizaje. Accepted: 2019-04-22T19:32:29Z, Jun. 2016. Available at: https://ri.conicet.gov.ar/handle/11336/74714. Accessed on: 16 Nov. 2021.

GARCÍA, A. M.; IBÁÑEZ, A. A touch with words: Dynamic synergies between manual actions and language. **Neuroscience & Biobehavioral Reviews**, [*S. l.*], vol. 68, p. 59–95, 1 Sep. 2016.

GENTNER, D. Cognitive Science Is and Should Be Pluralistic. **Topics in Cognitive Science**, [*S. l.*], vol. 11, no. 4, p. 884–891, Oct. 2019.

GENTNER, D. Metaphor as Structure Mapping: The Relational Shift. **Child Development**, [*S. l.*], vol. 59, no. 1, p. 47–59, 1988.

GENTNER, D.; BOWDLE, B. Metaphor as structure-mapping. **The Cambridge handbook of metaphor and thought**. New York, NY, US: Cambridge University Press, 2008. p. 109–128.

GENTNER, D.; IMAI, M.; BORODITSKY, L. As time goes by: Evidence for two systems in processing space → time metaphors. **Language and Cognitive Processes**, [*S. l.*], vol. 17, no. 5, p. 537–565, Oct. 2002.

GENTNER, D.; STEVENS, A. L. (Eds.). Flowing Waters or Teeming Crowds: Mental Models of Electricity. **Mental Models**. 0 ed. [*S. l.*]: Psychology Press, 2014. p. 107–138. Available at: https://www.taylorfrancis.com/books/9781317769408/chapters/10.4324/9781315802725-10. Accessed on: 23 Feb. 2022.

GENTNER, D.; WOLFF, P. Metaphor and knowledge change. **Cognitive dynamics: Conceptual and representational change in humans and machines**. Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers, 2000. p. 295–342.

GEORGE, D. R.; WHITEHOUSE, P. J. The War (on Terror) on Alzheimer's. **Dementia**, [*S. l.*], vol. 13, no. 1, p. 120–130, 1 Jan. 2014.

GERNSBACHER, M. A. *et al.* The Role of Suppression and Enhancement in Understanding Metaphors. **Journal of Memory and Language**, [*S. l.*], vol. 45, no. 3, p. 433–450, 1 Oct. 2001.

GIBBS, J., Raymond W. **Embodiment and Cognitive Science**. Cambridge: Cambridge University Press, 2005. Available at: https://www.cambridge.org/core/books/embodiment-and-cognitive-science/DCD48CB331B256F32402855AEAAFC46D. Accessed on: 13 Nov. 2021.

GIBBS JR, R. W. **Metaphor Wars: Conceptual Metaphors in Human Life**. Cambridge: Cambridge University Press, 2017. Available at: http://ebooks.cambridge.org/ref/id/CBO9781107762350. Accessed on: 25 Oct. 2021.

GIBBS, R. Metaphor, language, and dynamical systems. **The Routledge Handbook of Metaphor and Language**. New York: Routledge, 2017. p. 56–70.

GIBBS, R. The real complexities of psycholinguistic research on metaphor. **Language Sciences**, [*S. l.*], vol. 40, p. 45–52, 1 Nov. 2013.

GIBBS, R. W. Are ‘deliberate’ metaphors really deliberate?: A question of human consciousness and action. **Metaphor and the Social World**, [*S. l.*], vol. 1, no. 1, p. 26–52, 3 Aug. 2011.

GIBBS, R. W. Does deliberate metaphor theory have a future? **Journal of Pragmatics**, [*S. l.*], vol. 90, p. 73–76, Dec. 2015.

GIBBS, R. W. Evaluating Contemporary Models of Figurative Language Understanding. **Metaphor and Symbol**, [*S. l.*], vol. 16, no. 3–4, p. 317–333, Oct. 2001.

GIBBS, R. W. Metaphor as Dynamical–Ecological Performance. **Metaphor and Symbol**, [*S. l.*], vol. 34, no. 1, p. 33–44, 2 Jan. 2019.

GIBBS, R. W. Metaphoric cognition as social activity: Dissolving the divide between metaphor in thought and communication. **Metaphor and the Social World**, [*S. l.*], vol. 3, no. 1, p. 54–76, 18 Jul. 2013.

GIBBS, R. W. Spilling the beans on understanding and memory for idioms in conversation. **Memory & Cognition**, [*S. l.*], vol. 8, no. 2, p. 149–156, 1 Mar. 1980.

GIBBS, R. W. Stability and variability in linguistic pragmatics. **Pragmatics and Society**, [*S. l.*], vol. 1, no. 1, p. 32–49, 27 Aug. 2010.

GIBBS, R. W.; CHEN, E. Taking metaphor studies back to the Stone Age: A reply to Xu, Zhang, and Wu (2016). **Intercultural Pragmatics**, [*S. l.*], vol. 14, no. 1, 1 Jan. 2017. Available at: https://www.degruyter.com/document/doi/10.1515/ip-2017-0005/html. Accessed on: 25 Oct. 2021.

GIBBS, R. W. G.; COLSTON, H. L. **Interpreting Figurative Meaning**. [*S. l.*]: Cambridge University Press, 2012.

GIBBS, R. W.; PERLMAN, M. The contested impact of cognitive linguistic research on the psycholinguistics of metaphor understanding. **The contested impact of cognitive linguistic**. [*S. l.*]: De Gruyter Mouton, 2008. p. 211–228. Available at: https://www.degruyter.com/document/doi/10.1515/9783110197761.3.211/html. Accessed on: 30 Jan. 2022.

GIBBS, R. W.; SANTA CRUZ, M. J. Temporal Unfolding of Conceptual Metaphoric Experience. **Metaphor and Symbol**, [*S. l.*], vol. 27, no. 4, p. 299–311, 1 Oct. 2012.

GIBBS, R. W.; SIMAN, J. How We Resist Metaphors. **Language and Cognition**, [*S. l.*], vol. 13, no. 4, p. 670–692, Dec. 2021.

GIBBS, R. W.; VAN ORDEN, G. Pragmatic Choice in Conversation. **Topics in Cognitive Science**, [*S. l.*], vol. 4, no. 1, p. 7–20, 2012.

GIERE, R. N. **Science Without Laws**. [*S. l.*]: University of Chicago Press, 1999.

GIERE, R. N. **Scientific perspectivism**. Chicago, IL, US: University of Chicago Press, 2006. p. 151(Scientific perspectivism151).

GIGERENZER, G. From tools to theories: A heuristic of discovery in cognitive psychology. **Psychological Review**, [*S. l.*], US, vol. 98, no. 2, p. 254–267, 1991.

GILDEA, P.; GLUCKSBERG, S. On understanding metaphor: The role of context. **Journal of Verbal Learning & Verbal Behavior**, [*S. l.*], Netherlands, vol. 22, no. 5, p. 577–590, 1983.

GIORA, R. Is metaphor unique? *In*: GIBBS, Jr., Raymond W. (ed.). **The Cambridge Handbook of Metaphor and Thought**. Cambridge Handbooks in Psychology. Cambridge: Cambridge University Press, 2008. p. 143–160. Available at: https://www.cambridge.org/core/books/cambridge-handbook-of-metaphor-and-thought/is-metaphor-unique/59D0B5E0ADDE5D4A221B9621A2B8625F. Accessed on: 31 Jan. 2022.

GLEICK, J. **Chaos: making a new science**. New York: Penguin Books, 1988.

GLUCKSBERG, S. How metaphors create categories--quickly. **The Cambridge handbook of metaphor and thought**. New York, NY, US: Cambridge University Press, 2008. p. 67–83.

GLUCKSBERG, S.; BROWN, M.; MCGLONE, M. S. Conceptual metaphors are not automatically accessed during idiom comprehension. **Memory & Cognition**, [*S. l.*], vol. 21, no. 5, p. 711–719, 1 Sep. 1993.

GLUCKSBERG, S.; HAUGHT, C. Can Florida Become Like the Next Florida?: When Metaphoric Comparisons Fail. **Psychological Science**, [*S. l.*], vol. 17, no. 11, p. 935–938, 1 Nov. 2006.

GLUCKSBERG, S.; MCGLONE, M. When love is not a journey: What metaphors mean. **Journal of Pragmatics**, [*S. l.*], vol. 31, p. 1541–1558, 1 Nov. 1999.

GLUCKSBERG, S.; NEWSOME, M.; GOLDVARG, Y. Inhibition of the Literal: Filtering Metaphor-Irrelevant Information During Metaphor Comprehension. **Metaphor and Symbol - METAPHOR SYMB**, [*S. l.*], vol. 16, p. 277–293, 1 Oct. 2001.

GOATLY, A. **Washing the Brain – Metaphor and Hidden Ideology**. Amsterdam: John Benjamins Publishing Company, 2007. Available at: https://benjamins.com/catalog/dapsac.23. Accessed on: 23 Feb. 2022.

GODFREY-SMITH, P. **Theory and Reality: An Introduction to the Philosophy of Science**. [*S. l.*]: University of Chicago Press, 2003.

GOERTZEL, B. **Chaotic Logic Language, Thought, and Reality From the Perspective of Complex Systems Science**. [*S. l.*]: Springer Science & Business Media, 1994.

GONZÁLEZ, J. *et al.* Reading cinnamon activates olfactory brain regions. **NeuroImage**, [*S. l.*], vol. 32, p. 906–12, 1 Sep. 2006.

GRADY, J. Foundations of Meaning: Primary Metaphors and Primary Scenes. [*S. l.*], 1997. Available at: https://escholarship.org/uc/item/3g9427m2. Accessed on: 4 Feb. 2022.

GROUP, P. MIP: A Method for Identifying Metaphorically Used Words in Discourse. **Metaphor and Symbol**, [*S. l.*], vol. 22, no. 1, p. 1–39, 1 Jan. 2007.

GUILFORD, J. P. Creativity: Yesterday, today, and tomorrow. **The Journal of Creative Behavior**, [*S. l.*], US, vol. 1, no. 1, p. 3–14, 1967.

HARLOW, H. F. The nature of love. **American Psychologist**, [*S. l.*], US, vol. 13, no. 12, p. 673–685, 1958.

HART, C. Animals vs. armies: Resistance to extreme metaphors in anti-immigration discourse. **Journal of Language and Politics**, [*S. l.*], vol. 20, no. 2, p. 226–253, 22 Mar. 2021.

HART, C. 'Riots engulfed the city': An experimental study investigating the legitimating effects of fire metaphors in discourses of disorder. **Discourse & Society**, [*S. l.*], vol. 29, p. 095792651773466, 9 Nov. 2017.

HAUSER, D.; CARTER, M.; MEIER, B. Mellow Monday and furious Friday: The approach-related link between anger and time representation. **Cognition and Emotion**, [*S. l.*], vol. 23, 27 Jul. 2009.

HAUSER, D. J.; SCHWARZ, N. The war on prevention: bellicose cancer metaphors hurt (some) prevention intentions. **Personality & Social Psychology Bulletin**, [*S. l.*], vol. 41, no. 1, p. 66–77, Jan. 2015.

HEERSMINK, R. Varieties of the extended self. **Consciousness and Cognition**, [*S. l.*], vol. 85, p. 103001, 1 Oct. 2020.

HOFFMAN, D. D.; SINGH, M.; PRAKASH, C. The Interface Theory of Perception. **Psychonomic Bulletin & Review**, [*S. l.*], vol. 22, no. 6, p. 1480–1506, 1 Dec. 2015.

HOFKIRCHNER, W.; SCHAFRANEK, M. General System Theory. *In*: HOOKER, C. (ed.). **Philosophy of Complex Systems**. Handbook of the Philosophy of Science. Amsterdam: North-Holland, 2011. vol. 10, p. 177–194. Available at: https://www.sciencedirect.com/science/article/pii/B9780444520760500067. Accessed on: 31 Jan. 2022.

HOFSTADTER, D. R. **Godel, Escher, Bach**. New York: Basic Books, 1979.

HOFSTADTER, D. R.; SANDER, E. **Surfaces and essences: analogy as the fuel and fire of thinking**. New York: Basic Books, 2013.

HOFSTADTER, M.; REZNICK, J. S. Response modality affects human infant delayed-response performance. **Child Development**, [*S. l.*], United Kingdom, vol. 67, no. 2, p. 646–658, 1996.

HOLLAND, J. H. Laguage aquisition as complex adaptative system. **Language Acquisition, Change and Emergence: Essays in Evolutionary Linguistics**. Hong Kong: City University of Hong Kong Press, 2005.

HOLYOAK, K. J.; STAMENKOVIĆ, D. Metaphor comprehension: A critical review of theories and evidence. **Psychological Bulletin**, [*S. l.*], US, vol. 144, no. 6, p. 641–671, 2018.

HUBEL, D. H. **Eye, brain, and vision**. New York: Scientific American Library, 1988.

JORDAN, J. S.; SRINIVASAN, N.; VAN LEEUWEN, C. The role of complex systems theory in cognitive science. **Cognitive Processing**, [*S. l.*], vol. 16, no. 4, p. 315–317, 1 Nov. 2015.

JUARRERO, A. **Dynamics in action: intentional behavior as a complex system**. Cambridge, Mass: MIT Press, 1999.

KAHNEMAN, D.; SLOVIC, P.; TVERSKY, A. (Eds.). **Judgment under Uncertainty: Heuristics and Biases**. Cambridge: Cambridge University Press, 1982. Available at: https://www.cambridge.org/core/books/judgment-under-uncertainty/6F9E814794E08EC43D426E480A4B412C. Accessed on: 7 Nov. 2021.

KATZ, A. N.; AL-AZARY, H. Principles That Promote Bidirectionality in Verbal Metaphor. **Poetics Today**, [*S. l.*], vol. 38, no. 1, p. 35–59, 1 Feb. 2017.

KELSO, J. A. S. **Dynamic patterns: the self-organization of brain and behavior**. Cambridge, Mass: MIT Press, 1995.

KIEFER, M. *et al.* The Sound of Concepts: Four Markers for a Link between Auditory and Conceptual Brain Systems. **Journal of Neuroscience**, [*S. l.*], vol. 28, no. 47, sec. Articles, p. 12224–12230, 19 Nov. 2008.

KIEFER, M. *et al.* Tracking the Time Course of Action Priming on Object Recognition: Evidence for Fast and Slow Influences of Action on Perception. **Journal of Cognitive Neuroscience**, [*S. l.*], vol. 23, no. 8, p. 1864–1874, Aug. 2011.

KORN, H.; FAURE, P. Is there chaos in the brain? II. Experimental evidence and related models. **Comptes Rendus Biologies**, [*S. l.*], vol. 326, no. 9, p. 787–840, 1 Sep. 2003.

KÖVECSES, Z. Levels of metaphor. **Cognitive Linguistics**, [*S. l.*], vol. 28, no. 2, p. 321–347, 1 May 2017.

KÖVECSES, Z. Some consequences of a multi-level view of metaphor. *In*: NAVARRO I FERRANDO, I. (ed.). **Current Approaches to Metaphor Analysis in Discourse**. [*S. l.*]: De Gruyter, 2019. p. 19–34. Available at: https://www.degruyter.com/document/doi/10.1515/9783110629460-002/html. Accessed on: 25 Oct. 2021.

KÖVECSES, Z. **Where Metaphors Come From: Reconsidering Context in Metaphor**. New York: Oxford University Press, 2015. Available at: https://oxford.universitypressscholarship.com/10.1093/acprof:oso/9780190224868.001.0001/acprof-9780190224868. Accessed on: 13 Nov. 2021.

KRAKAUER, D. *et al.* The information theory of individuality. **Theory in Biosciences**, [*S. l.*], vol. 139, no. 2, p. 209–223, 1 Jun. 2020.

KRAWCZYK, M.; SMYK, M. Author′s gender affects rating of academic articles: Evidence from an incentivized, deception-free laboratory experiment. **European Economic Review**, [*S. l.*], vol. 90, p. 326–335, 1 Nov. 2016.

KRUGLANSKI, A. W. *et al.* On The Parameters of Human Judgment. **Advances in Experimental Social Psychology**. [*S. l.*]: Academic Press, 2007. vol. 39, p. 255–303. Available at: https://www.sciencedirect.com/science/article/pii/S0065260106390053. Accessed on: 23 Feb. 2022.

LACAL, I.; VENTURA, R. Epigenetic Inheritance: Concepts, Mechanisms and Perspectives. **Frontiers in Molecular Neuroscience**, [*S. l.*], vol. 11, p. 292, 28 Sep. 2018.

LAI, V. T.; HOWERTON, O.; DESAI, R. H. Concrete processing of action metaphors: Evidence from ERP. **Brain Research**, [*S. l.*], vol. 1714, p. 202–209, 1 Jul. 2019.

LAKATOS, I. **The Methodology of Scientific Research Programmes: Philosophical Papers**. 1st ed. [*S. l.*]: Cambridge University Press, 1978. Available at: https://www.cambridge.org/core/product/identifier/9780511621123/type/book. Accessed on: 25 Oct. 2021.

LAKOFF, G. The Contemporary Theory of Metaphor. *In*: ORTONY, A.**Metaphor and Thought**. Cambridge: Cambridge University Press, 1993. p. 202–251.

LAKOFF, G.; JOHNSON, M. **Metaphors we live by**. Chicago: University of Chicago Press, 1980.

LAKOFF, G.; NÚÑEZ, R. E. **Where mathematics comes from: how the embodied mind brings mathematics into being**. Nachdr. New York, NY: Basic Books, 2000.

LANDAU, M.; ZHONG, C.; SWANSON, T. Conceptual metaphors shape consumer psychology. **Consumer Psychology Review**, [*S. l.*], vol. 1, 16 Dec. 2017.

LANE, H. P.; MCLACHLAN, S.; PHILIP, J. The war against dementia: are we battle weary yet? **Age and Ageing**, [*S. l.*], vol. 42, no. 3, p. 281–283, 1 May 2013.

LARSEN-FREEMAN, D.; CAMERON, L. **Complex systems and applied linguistics**. Oxford: Oxford university press, 2008(Oxford applied linguistics).

LEKVAM, T.; GAMBÄCK, B.; BUNGUM, L. Agent-based modeling of language evolution. Apr. 2014. **Proceedings of the 5th Workshop on Cognitive Aspects of Computational Language Learning (CogACLL)** [...]. Gothenburg, Sweden: Association for Computational Linguistics, Apr. 2014. p. 49–54. Available at: https://aclanthology.org/W14-0510. Accessed on: 31 Jan. 2022.

LEWIS, M. D. The emergence of mind in the emotional brain. *In*: DEMETRIOU, A.; RAFTOPOULOS, A. (eds.). **Cognitive Developmental Change**. 1st ed. [*S. l.*]: Cambridge University Press, 2005. p. 217–240. Available at: https://www.cambridge.org/core/product/identifier/CBO9780511489938A014/type/book_part. Accessed on: 20 Oct. 2021.

LITTLEMORE, J. *et al*. Difficulties in Metaphor Comprehension Faced by International Students whose First Language is not English. **Applied Linguistics**, [*S. l.*], vol. 32, no. 4, p. 408–429, 1 Sep. 2011.

LITTLEMORE, J. The Effect of Cultural Background on Metaphor Interpretation. **Metaphor and Symbol**, [*S. l.*], vol. 18, no. 4, p. 273–288, 1 Oct. 2003.

LITTLEMORE, J. The Use of Metaphor in University Lectures and the Problems that it Causes for Overseas Students. **Teaching in Higher Education**, [*S. l.*], vol. 6, no. 3, p. 333–349, 1 Jul. 2001.

LURIA, A. R. **Cognitive development: Its cultural and social foundations. (Trans M. Lopez-Morillas & L. Solotaroff)**. Oxford, England: Harvard U Press, 1976. p. xvi, 175(Cognitive development: Its cultural and social foundations. (Trans M. Lopez-Morillas & L. Solotaroff)xvi, 175).

MASSIMI, M. Perspectivism. **The Routledge Handbook of Scientific Realism**, [*S. l.*], , p. 164–175, 15 Dec. 2017.

MCELREATH, R.; SMALDINO, P. E. Replication, Communication, and the Population Dynamics of Scientific Discovery. **PLOS ONE**, [*S. l.*], vol. 10, no. 8, p. e0136088, 26 Aug. 2015.

MCGLONE, M. What Is the Explanatory Value of a Conceptual Metaphor? **Language & Communication**, [*S. l.*], vol. 27, p. 109–126, 1 Apr. 2007.

MCGLONE, M. S. Conceptual Metaphors and Figurative Language Interpretation: Food for Thought? **Journal of Memory and Language**, [*S. l.*], vol. 35, no. 4, p. 544–565, 1 Aug. 1996.

MILLER, B. When is Consensus Knowledge Based? Distinguishing Shared Knowledge From Mere Agreement. **Synthese**, [*S. l.*], vol. 190, no. 7, p. 1293–1316, 2013.

MILLER, K. A.; RANEY, G. E.; DEMOS, A. P. Time to Throw in the Towel? No Evidence for Automatic Conceptual Metaphor Access in Idiom Processing. **Journal of Psycholinguistic Research**, [*S. l.*], vol. 49, no. 5, p. 885–913, Oct. 2020.

MITCHELL, M. **Complexity: a guided tour**. Oxford [England] ; New York: Oxford University Press, 2009.

MORCOL, G. What Is Complexity Science? Postmodernist or Psotpositivist? **Emergence**, [*S. l.*], vol. 3, no. 1, p. 104–119, 1 Apr. 2001.

MURPHY, G. L. On metaphoric representation. **Cognition**, [*S. l.*], vol. 60, no. 2, p. 173–204, 1 Aug. 1996.

NEWEN, A.; DE BRUIN, L.; GALLAGHER, S. **The Oxford Handbook of 4E Cognition**. Oxford, New York: Oxford University Press, 2018(Oxford Library of Psychology).

NGATCHA-RIBERT, L. [Alzheimer disease and society: an analysis of its social representation]. **Psychologie & Neuropsychiatrie Du Vieillissement**, [*S. l.*], vol. 2, no. 1, p. 49–66, Mar. 2004.

ORTONY, A. Beyond literal similarity. **Psychological Review**, [*S. l.*], US, vol. 86, no. 3, p. 161–180, 1979.

OUSHIRO, L. **Introdução à Estatística para Linguistas**. Campinas: To be published, 2021. Available at: https://zenodo.org/record/4755739#.YhUys5TMKUk.

PAOLO, E. A. D.; CUFFARI, E. C.; JAEGHER, H. de. **Linguistic Bodies: The Continuity Between Life and Language**. Cambridge, Massachusetts: MIT Press, 2018.

PELEG, O.; GIORA, R.; FEIN, O. Salience and Context Effects: Two Are Better Than One. **Metaphor and Symbol**, [*S. l.*], vol. 16, p. 173–192, 1 Oct. 2001.

PERONE, S.; SIMMERING, V. R. Applications of Dynamic Systems Theory to Cognition and Development. **Advances in Child Development and Behavior**. [*S. l.*]: Elsevier, 2017. vol. 52, p. 43–80. Available at: https://linkinghub.elsevier.com/retrieve/pii/S0065240716300416. Accessed on: 20 Oct. 2021.

PEXMAN, P.; FERRETTI, T.; KATZ, A. Discourse Factors That Influence Online Reading of Metaphor and Irony. **DISCOURSE PROCESSES Copyright**, [*S. l.*], vol. 29, p. 201–222, 1 May 2000.

PIAGET, J. **The construction of reality in the child**. New York, NY, US: Basic Books, 1954. p. xiii, 386(The construction of reality in the childxiii, 386).

PINKER, S. Block That Metaphor! **The New Republic**, [*S. l.*], 9 Oct. 2006. Available at: https://newrepublic.com/article/77730/block-metaphor-steven-pinker-whose-freedom-george-lakoff. Accessed on: 23 Feb. 2022.

PINKER, S. **How the Mind Works**. Illustrated edição. New York: W. W. Norton & Company, 2009.

PULVERMÜLLER, F. Brain Mechanisms Linking Language and Action. **Nature reviews. Neuroscience**, [*S. l.*], vol. 6, p. 576–82, 1 Aug. 2005.

PULVERMÜLLER, F. Neurobiological Mechanisms for Semantic Feature Extraction and Conceptual Flexibility. **Topics in Cognitive Science**, [*S. l.*], vol. 10, no. 3, p. 590–620, 2018.

PULVERMÜLLER, F.; FADIGA, L. Active perception: sensorimotor circuits as a cortical basis for language. **Nature Reviews. Neuroscience**, [*S. l.*], vol. 11, no. 5, p. 351–360, May 2010.

RACHLIN, H. Group selection in behavioral evolution. **Behavioural Processes**, [*S. l.*], vol. 161, p. 65–72, 1 Apr. 2019.

REIJNIERSE, W. G. *et al.* DMIP: A Method for Identifying Potentially Deliberate Metaphor in Language Use. **Corpus Pragmatics**, [*S. l.*], vol. 2, no. 2, p. 129–147, Jun. 2018.

ROBINS, S.; MAYER, R. E. The Metaphor Framing Effect: Metaphorical Reasoning About Text-Based Dilemmas. **Discourse Processes**, [*S. l.*], vol. 30, no. 1, p. 57–86, 1 Jul. 2000.

SABUCEDO, J.-M.; ALZATE, M.; HUR, D. COVID-19 and the metaphor of war (COVID-19 y la metáfora de la guerra). **International Journal of Social Psychology**, [*S. l.*], vol. 35, no. 3, p. 618–624, 1 Sep. 2020.

SAPOLSKY, R.; BALT, S. Reductionism and Variability in Data: A Meta-Analysis. **Perspectives in Biology and Medicine**, [*S. l.*], vol. 39, no. 2, p. 193–203, 1996.

SAPOLSKY, R. M. **Behave: the biology of humans at our best and worst**. New York, New York: Penguin Press, 2017.

SAUCIUC, G.-A. The Role of Metaphor in the Structuring of Emotion Concepts. **Cognitive Semiotics**, [*S. l.*], vol. 5, no. 1–2, p. 244–267, 1 Dec. 2009.

SCHOTTER, E. R. *et al.* Task effects reveal cognitive flexibility responding to frequency and predictability: evidence from eye movements in reading and proofreading. **Cognition**, [*S. l.*], vol. 131, no. 1, p. 1–27, Apr. 2014.

SCOVEL, T. Why Languages Do not Shape Cognition: Psycho- and Neurolinguistic Evidence. **Jalt Journal**, [*S. l.*], vol. 13, p. 43–56, 1991.

SEMINO, E. "Not Soldiers but Fire-fighters" – Metaphors and Covid-19. **Health Communication**, [*S. l.*], vol. 36, no. 1, p. 50–58, 2 Jan. 2021.

SHAFFER, Z. *et al.* The foundress's dilemma: group selection for cooperation among queens of the harvester ant, Pogonomyrmex californicus. **Scientific Reports**, [*S. l.*], vol. 6, no. 1, p. 29828, 28 Jul. 2016.

SIMAN, J. H.; FIGUEIREDO, N. M. de. Multiple representational and dynamic conceptual analysis in the wild. **Fórum Linguístico**, [*S. l.*], vol. 18, no. 3, sec. Fórum Linguístico, p. 6604–6621, 2021.

SIMAN, J. H.; SAMPAIO, T. O. da M. Teoria da metáfora conceptual: **Porto das Letras**, [*S. l.*], vol. 7, no. 1, p. 201–220, 7 Feb. 2021.

SIMAN, J. H.; SAMPAIO, T. O. da M.; GONZALEZ-MARQUEZ, M. How do metaphors shape thought in the wild? **Cadernos de Tradução**, [*S. l.*], no. 46, p. 136–156, 27 Sep. 2021.

SIMONS, D. J.; CHABRIS, C. F. Gorillas in our midst: sustained inattentional blindness for dynamic events. **Perception**, [*S. l.*], vol. 28, no. 9, p. 1059–1074, 1999.

SINGHAM, M. **The great paradox of science: why its conclusions can be relied upon even though they cannot be proven**. New York: Oxford University Press, 2020.

SMALDINO, P. E. Models Are Stupid, and We Need More of Them. *In*: VALLACHER, R. R.; READ, S. J.; NOWAK, A.**Computational Social Psychology**. New York ; London: Routledge, Taylor & Francis Group, 2017.

SMITH, L. B. *et al.* Knowing in the context of acting: The task dynamics of the A-not-B error. **Psychological Review**, [*S. l.*], US, vol. 106, no. 2, p. 235–260, 1999.

SPERBER, D.; WILSON, D. A deflationary account of metaphors. *In*: SPERBER, D.; WILSON, D. (eds.). **Meaning and Relevance**. Cambridge: Cambridge University Press, 2012. p. 97–122. Available at: https://www.cambridge.org/core/books/meaning-and-relevance/deflationary-account-of-metaphors/8DE457ED79575516CFC01907F18E4AFA. Accessed on: 31 Jan. 2022.

SPIVEY, M. **The continuity of mind**. Oxford ; New York: Oxford University Press, 2007(Oxford psychology series, 44).

SPIVEY, M. J. **Who You Are: The Science of Connectedness**. Cambridge, MA, USA: MIT Press, 2020.

STADDON, J. **The New Behaviorism: Foundations of Behavioral Science**. 3rd ed. edição. New York: Routledge, 2021a.

STADDON, J. Theoretical Behaviorism. *In*: ZILIO, D.; CARRARA, K. (eds.). **Contemporary Behaviorisms in Debate**. Cham: Springer International Publishing, 2021b. p. 79–95. Available at: https://doi.org/10.1007/978-3-030-77395-3_7. Accessed on: 30 Jan. 2022.

STEELS, L. Agent-based models for the emergence and evolution of grammar. **Philosophical Transactions of the Royal Society B: Biological Sciences**, [*S. l.*], vol. 371, no. 1701, p. 20150447, 19 Aug. 2016.

STEEN, G. Deliberate Metaphor Theory: Basic assumptions, main tenets, urgent issues. **Intercultural Pragmatics**, [*S. l.*], vol. 14, no. 1, p. 1–24, 1 Jan. 2017.

STEEN, G. J. *et al.* **A Method for Linguistic Metaphor Identification: From MIP to MIPVU: 14**. Amsterdam ; Philadelphia: John Benjamins Publishing Company, 2010.

STEEN, G. J. The contemporary theory of metaphor — now new and improved! 2008. **rcl.9.1.03ste**. Available at: https://benjamins.com/catalog/rcl.9.1.03ste. Accessed on: 25 Oct. 2021.

SVANLUND, J. Metaphor and convention. [*S. l.*], vol. 18, no. 1, sec. Cognitive Linguistics, p. 47–89, 20 Mar. 2007.

TEAM, R. C. **R: A language and environment for statistical computing.** Vienna: R Foundation for Statistical Computing, 2020. Available at: https://www.R-project.org/.

TENDAHL, M.; GIBBS, R. W. Complementary perspectives on metaphor: Cognitive linguistics and relevance theory. **Journal of Pragmatics**, [*S. l.*], vol. 40, no. 11, p. 1823–1864, 1 Nov. 2008.

THIBODEAU, P.; DURGIN, F. H. Productive figurative communication: Conventional metaphors facilitate the comprehension of related novel metaphors. **Journal of Memory and Language**, [*S. l.*], vol. 58, no. 2, p. 521–540, 1 Feb. 2008.

THIBODEAU, P. H.; BORODITSKY, L. Metaphors We Think With: The Role of Metaphor in Reasoning. **PLoS ONE**, [*S. l.*], vol. 6, no. 2, p. e16782, 23 Feb. 2011.

THIBODEAU, P. H.; MATLOCK, T.; FLUSBERG, S. J. The role of metaphor in communication and thought. **Language and Linguistics Compass**, [*S. l.*], vol. 13, no. 5, p. e12327, 2019.

TRANQUILLO. **An Introduction to Complex Systems**. New York, NY: [*s. n.*], 2019.

TURNER, M. **The Origin of Ideas: Blending, Creativity, and the Human Spark**. [*S. l.*]: OUP USA, 2014.

TVERSKY, A.; KAHNEMAN, D. Extensional versus intuitive reasoning: The conjunction fallacy in probability judgment. **Psychological Review**, [*S. l.*], US, vol. 90, no. 4, p. 293–315, 1983.

VIGLIOCCO, G. *et al.* Toward a theory of semantic representation. **Language and Cognition**, [*S. l.*], vol. 1, no. 2, p. 219–247, Jun. 2009.

WALKER, J. **George Lakoff Sells His Old Snake Oil in a New Bottle**. 30 Jul. 2012. **Reason.com**. Available at: https://reason.com/2012/07/30/george-lakoff-sells-his-old-snake-oil-in/. Accessed on: 23 Feb. 2022.

WANG, Y.; LIU, H.; SUN, Z. Lamarck rises from his grave: parental environment-induced epigenetic inheritance in model organisms and humans. **Biological Reviews**, [*S. l.*], vol. 92, no. 4, p. 2084–2111, 2017.

WAY, E. C. **Knowledge Representation and Metaphor**. Dordrecht: Springer Netherlands, 1991. vol. 7, (Studies in Cognitive Systems). Available at: http://link.springer.com/10.1007/978-94-015-7941-4. Accessed on: 20 Oct. 2021.

WICKHAM, H. *et al.* Welcome to the Tidyverse. **Journal of Open Source Software**, [*S. l.*], vol. 4, p. 1686, 21 Nov. 2019.

WILLIAMS, L. E.; BARGH, J. A. Experiencing Physical Warmth Promotes Interpersonal Warmth. **Science**, [*S. l.*], vol. 322, no. 5901, p. 606–607, 24 Oct. 2008.

WILSON, A. D. Ecological Mechanistic Research and Modelling. [*S. l.*], 4 Jun. 2021. Available at: https://psyarxiv.com/8t6qk/. Accessed on: 31 Jan. 2022.

WILSON, D. S. A theory of group selection. **Proceedings of the National Academy of Sciences**, [*S. l.*], vol. 72, no. 1, sec. Research Article, p. 143–146, 1 Jan. 1975.

WILSON, David Sloan; WILSON, E. O. Evolution “for the Good of the Group”: The process known as group selection was once accepted unthinkingly, then was widely discredited; it’s time for a more discriminating assessment. **American Scientist**, [*S. l.*], vol. 96, no. 5, p. 380–389, 2008.

WILSON, N. L.; GIBBS JR., R. W. Real and Imagined Body Movement Primes Metaphor Comprehension. **Cognitive Science**, [*S. l.*], vol. 31, no. 4, p. 721–731, 2007.

WINTER, B. **Statistics for Linguists: An Introduction Using R**. New York: Routledge, 2019.

ZESTCOTT, C. A.; STONE, J.; LANDAU, M. J. The Role of Conscious Attention in How Weight Serves as an Embodiment of Importance. **Personality and Social Psychology Bulletin**, [*S. l.*], vol. 43, no. 12, p. 1712–1723, Dec. 2017.

# Annex

## 1 Approval of the Ethical Committee

REGISTRO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Estudo sobre metáforas
Josie Helen Siman
Thiago Oliveira da Motta Sampaio
Número do CAAE: 89298818.0.0000.8142

Você está sendo convidado a participar como voluntário de uma pesquisa. Este Registro de Consentimento Livre e Esclarecido, visa assegurar seus direitos como participante e é elaborado em duas vias, uma que deverá ficar com você e outra com o pesquisador.

Por favor, leia com atenção e calma, aproveitando para esclarecer suas dúvidas. Se houver perguntas antes ou mesmo depois de assiná-lo, você poderá esclarecê-las com o pesquisador (josiesiman@gmail.com). Se preferir, consultar seus familiares ou outras pessoas antes de decidir participar. Não haverá nenhum tipo de penalização ou prejuízo se você não aceitar participar ou retirar sua autorização em qualquer momento.

**Justificativa e objetivos:**
Este estudo tem por objetivo investigar os conhecimentos que temos sobre metáforas. Visamos avançar o entendimento científico de como a cognição humana funciona diante das tarefas desempenhadas pelos participantes deste estudo.

**Procedimentos:**
Participando do estudo você está sendo convidado a realizar tarefas que envolvem leitura de textos e respostas às questões referentes ao textos lidos. Além disso, também pedimos ao participante que preencha um questionário demográfico com perguntas gerais a seu respeito. Suas respostas às tarefas propostas neste estudo serão registradas, bem como suas respostas às questões do questionário. Toda a codificação dessas respostas bem como as análises são anônimas, ou seja, você não será identificado.

Observações:

· A participação no experimento e as respostas ao questionário levam em média 20 minutos (podendo o tempo ser maior ou menor, dependendo do seu ritmo de respostas).
· Os dados gerados nesta pesquisa serão guardados por tempo indeterminado (com garantia de absoluto anonimato do participante).

**Desconfortos e riscos:**
Você não deve participar deste estudo se tem qualquer impedimento para a realização de leituras e atividades interpretativas. Você não deve participar deste estudo se for menor de 18 anos, se não for falante nativo do Português Brasileiro, se tiver problemas de visão não corrigidas por óculos ou lentes de contato. Este experimento não apresenta riscos físicos, de saúde ou psicológicos previsíveis. É possível que o participante sinta algum desconforto ao responder a

um questionário. Se este for o caso, interrompa a atividade em caso de tonturas, cansaço excessivo ou qualquer outra anormalidade identificada.

**Benefícios:**
Os participantes deste estudo não serão beneficiados de maneira direta, mas frisamos que sua participação trará benefícios para o avanço da ciência no que diz respeito ao entendimento das relações entre a linguagem e a cognição.

**Acompanhamento e assistência:**
Embora a pesquisa em questão não consiga prever desconfortos causados diretamente pelos experimentos, a qualquer sinal de desconforto o experimento poderá interrompido pelo participante.

**Sigilo e privacidade:**
Você tem a garantia de que sua identidade será mantida em sigilo e nenhuma informação **identificada** será dada a outras pessoas que não façam parte da equipe de pesquisadores. Na divulgação dos resultados desse estudo, seu nome não será citado. Ao final do teste, suas respostas serão armazenadas de forma anônima (números) e para fins de análise estatística. Caso você deseje desistir de sua participação nesta pesquisa, isso pode ser feito a qualquer momento sem qualquer penalização. Após a publicação deste estudo em revistas científicas, os dados serão guardados de forma anônima por período indefinido, podendo ser usados para pesquisas.

**Ressarcimento e Indenização:**
Por se tratar de uma pesquisa online, não há previsão de ressarcimento. Você tem garantia ao direito à indenização em caso de danos diretamente relacionados à pesquisa quando estes forem comprovados segundo a legislação vigente.

**Contato:**
Em caso de dúvidas sobre a pesquisa, você poderá entrar em contato com os pesquisadores Josie Helen Siman, Rua Sério Buarque de Holanda, 571, Campinas, SP (IEL/UNICAMP), telefone: (19) 3521 1757, e-mail: josiesiman@gmail.com, ou Thiago Oliveira da Motta Sampaio, e-mail: thiagomotta@iel.unicamp.br.

Em caso de denúncias ou reclamações sobre sua participação e sobre questões éticas do estudo, você poderá entrar em contato com a secretaria do Comitê de Ética em Pesquisa em Ciências Humanas e Sociais (CEP-CHS) da UNICAMP das 08h30 às 11h30 e das 13h00 às 17h00 na Rua Bertrand Russell, 801, Bloco C, 2º piso, sala 05, CEP 13083-865, Campinas – SP; telefone (19) 3521-6836; e-mail: cepchs@unicamp.br.

**O Comitê de Ética em Pesquisa (CEP):**
O papel do CEP é avaliar e acompanhar os aspectos éticos de todas as pesquisas envolvendo seres humanos. A Comissão Nacional de Ética em Pesquisa (CONEP), tem por objetivo desenvolver a regulamentação sobre proteção dos seres humanos envolvidos nas pesquisas. Desempenha um papel coordenador da rede de Comitês de Ética em Pesquisa (CEPs) das instituições, além de assumir a função de órgão consultor na área de ética em pesquisas.

**Responsabilidade do Pesquisador:**
Asseguro ter cumprido as exigências da resolução 510/2016 CNS/MS e complementares na elaboração do protocolo e na obtenção deste Termo de Consentimento Livre e Esclarecido.

Asseguro, também, ter explicado e fornecido uma via deste documento ao participante. Informo que o estudo foi aprovado pelo CEP perante o qual o projeto foi apresentado e pela CONEP, quando pertinente. Comprometo-me a utilizar o material e os dados obtidos nesta pesquisa exclusivamente para as finalidades previstas neste documento ou conforme o consentimento dado pelo participante.

**Consentimento livre e esclarecido:**
Após ter recebido esclarecimentos sobre a natureza da pesquisa, seus objetivos, métodos, benefícios previstos, potenciais riscos e o incômodo que esta possa acarretar, aceito participar:

**( ) Li e aceito participar.**
**( ) Não aceito.**

## 2. Samples of responses and coding

The behavioral data from this thesis is available in open access at:
https://osf.io/mubex/

### A- Condition 1: Conventional Conceptual Metaphors

Below, you can find the responses participants gave in Brazilian Portuguese and their coding, considering type (conceptual metaphors or not) and novelty (old and novel). Some of the paraphrases of "Life is a Journey" include: life is a marathon, an eternal progression, a walk, an adventure, something long, a long way, a long way, a trip, a route. There is also information about familiarity, aptness, and conventionality.

| Group | Reply | Fam | Apt | Con | Typ | Typ2 | Old | Old2 |
|---|---|---|---|---|---|---|---|---|
| 1 | A vida é uma maratona | 5 | 5 | 5 | CM | 1 | O | 0 |
| 1 | A vida é uma eterna progressão | 5 | 4 | 3 | CM | 1 | N | 1 |
| 1 | A vida é uma caminhada | 5 | 3 | 3 | CM | 1 | O | 0 |
| 1 | A vida é uma aventuraA vida é longa | 4 | 5 | 5 | CM | 1 | O | 0 |
| 1 | A vida é algo longo. | 4 | 5 | 3 | CM | 1 | O | 0 |
| 1 | A vida é uma aventura. | 5 | 5 | 5 | CM | 1 | O | 0 |
| 1 | A vida é um caminho longo. | 4 | 3 | 2 | CM | 1 | O | 0 |
| 1 | A vida é um caminho longo. | 5 | 5 | 5 | CM | 1 | O | 0 |
| 1 | A vida é uma viageM | 4 | 3 | 3 | CM | 1 | O | 0 |
| 1 | A vida é um percurso | 4 | 3 | 5 | CM | 1 | O | 0 |

### B- Condition 2: Novel Conceptual Metaphors

Below, you can find responses to metaphors that are slightly more novel and less apt, like "life is a way". Responses included life is a journey, journey, route, long period of happenings, hard, linear, journey, a construction of things, a process.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2 | A vida é uma jornada | 5 | 5 | 5 | CM | 1 | O | 0 |
| 2 | A vida é uma jornada | 5 | 4 | 4 | CM | 1 | O | 0 |
| 2 | "A vida eh uma trajetoria." | 3 | 4 | 4 | CM | 1 | O | 0 |
| 2 | A vida é um longo período de acontecimentos. | 5 | 5 | 4 | AN | 0 | N | 1 |
| 2 | A vida é difícil, longa e com muitos obstáculos. | 5 | 5 | 5 | AT | 0 | N | 1 |
| 2 | A vida é linear, feita momentos | 5 | 5 | 5 | CM | 1 | N | 1 |
| 2 | A vida é uma jornada | 5 | 5 | 5 | CM | 1 | O | 0 |
| 2 | A vida é uma construção de coisas, trilhada pela pe | 5 | 3 | 5 | AN | 0 | N | 1 |
| 2 | A vida  é um processo, um trabalho contínuo. | 5 | 5 | 5 | CM | 1 | O | 0 |

### C- Condition 3: Novel Conceptual Metaphors (type 2)

Below, you can find responses to metaphors that are more novel and less apt (even if this example is not that different). For the metaphor “Life is a marathon”, participants said that life is a race, a walk of endurance, a race, life is walking a step at the time, a race, fast, hard, a constant competition, a log walk, a long route with obstacles.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3 | A vida é uma corrida | 5 | 5 | 5 | AN | 0 | O | 0 |
| 3 | A vida e uma caminhada de resistencia | 3 | 3 | 3 | CM | 1 | O | 0 |
| 3 | A vida é uma corrida. | 5 | 5 | 5 | AN | 0 | N | 1 |
| 3 | A vida é levada passo a passo, sem correria | 2 | 3 | 4 | CM | 1 | O | 0 |
| 3 | A vida é uma corrida. | 4 | 4 | 4 | AN | 0 | N | 1 |
| 3 | A vida é rápida. | 2 | 1 | 2 | AT | 0 | N | 1 |
| 3 | A vida é difícil. | 5 | 5 | 5 | AT | 0 | N | 1 |
| 3 | A vida é uma competição constante | 3 | 3 | 3 | AN | 0 | N | 1 |
| 3 | "A vida é uma longa caminhada" | 2 | 5 | 5 | CM | 1 | O | 0 |
| 3 | A vida é uma longa estrada com obstáculos. | 2 | 4 | 1 | CM | 1 | O | 0 |

## 3- List of metaphors used in experiments

### A- List for chapter 8

Primary, conceptual, and predicative metaphors and their translation:

- Metáforas primárias / Primary metaphors

Esta ideia é vazia. / This idea is empty.

Este é um currículo de peso. / This c.v. has weight.

Estou me sentindo para baixo. / I am feeling down.

João é frio./ John is cold.

Este problema é duro. / This problem is hard.

O preço da carne é alto. / The price of the meat is high.

A reputação dela é suja./ Her reputation is dirty.

O doente é um fardo. / The sick person is a burden.
Minha namorada é quente. / My girlfriend is hot.
Este livro é profundo./ This book is deep.

- Metáforas Conceptuais / Conceptual Complex Metaphors

A vida é uma jornada./ Life is a journey.
A teoria dele é um edifício./ His theory is a building.
A palavra é uma arma./ The word is a weapon.
O amor é uma guerra./ Love is war.
Tempo é dinheiro./ Time is money.
A mente é um computador. / The mind is a computer.
Câncer é um inimigo. / Cancer is na enemy.
O conhecimento é uma luz. / Knowledge is light.
A sociedade é um corpo. / Society is a body.
Nosso relacionamento é uma montanha-russa./ Our relationship is a roller coaster ride.

- Metáforas não conceptuais / Predicative Metaphors

Roberto é um leão./ Robert is a Lion.
Minha sogra é uma cobra./ My mother-in-law is a snake.
Meu cunhado é uma mala sem alça./ My brother-in-law is a bag (= annoying).
Irene é um furacão. / Irene is a hurricane.
Meu filho é um anjo. / My son is an angel.
Meu cirurgião é um açougueiro./ My surgeon is a butcher.
Sandra é uma flor. / Sandra is a flower.
Ricardo é um deus grego. / Richard is a greek god.
Meu tio é uma pedra. / My unckle is a stone.
Lucas é um rato./ Lucas is rat.

**B- List for chapter 9**

A vida é uma jornada/caminhada/ maratona.
A palavra é uma arma/ metralhadora/ bomba.
O amor é uma luta/ partida de boxe/ partida de vale-tudo.
Tempo é dinheiro/ riqueza/ jóia.
A mente é um computador/notebook/ celular.
Câncer é um inimigo/ rival / antagonista.
O conhecimento é uma luz/ vela/ abajur.
A crença dele é uma doença/enfermidade/comorbidade.
Pessoas são máquinas/ robôs/ eletrônicos.
Ideias são sementes/ brotos/ arbustos.
João é frio / uma geleira/ um Alasca.
Teorias são edifícios/ prédios/ palácios.

**Translation**

Life is a journey/ walk/ marathon.
The word is a weapon/ machine gun/ bomb.
Love is a fight/ box match/ MMA match.
Time is money/ richness/ jewel.
The mind is a computer/ notebook/ cellphone.
Cancer is an enemy/ rival/ antagonist.
Knowledge is light/ candle/ lamp.
His beliefs are a disease/ infirmity/ comorbidity.
People are machines/ robots/ electronics.
Ideas are seeds/ buds/ bushes.
John is cold/ a glacier/ an Alaska.
Theories are buildings/ edifices/ palaces.