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Metaphorical priming: an analysis of Brazilian speakers' language processing

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"Im Anfang war das Wort, In ihm war Leben, und das Leben war das Licht der Menschen.
Und das Licht scheint in der Finsternis, und die Finsternis hat es nicht erfasst."
(Johannes 1:1, 4-5)

Resumo

O controle inibitório é um importante componente da cognição humana, e está presente tanto em processos linguísticos como não linguísticos. O presente estudo buscou investigar o papel do controle inibitório (CI) no processamento de *targets* que acompanham um priming metafórico. Os sujeitos de pesquisa leram um priming metafórico (ex.: Meu computador é uma lesma), um priming literal (ex.: Aquele molusco é uma lesma), ou um priming-baseline. Os primings-baseline não tinham relação com a metáfora do trial (ex.: Aquele rapaz é um doce). O priming literal foi transformado em um priming sem sentido em metade das sentenças experimentais (ex.: Aquela garrafa é uma lesma). Os tempos de reação para sentenças qualitativas relevantes ao sentido metafórico do veículo (ex.: Lesmas são lentas) foram mais rápidos quando participantes liam o priming metafórico do que quando liam o priming literal. Por outro lado, os tempos de reação para sentenças qualitativas foram mais lentos quando relacionado ao sentido literal do veículo (ex.: Lesmas são moluscos). Estes resultados, não obstante, apenas foram encontrados no componente offline de nosso experimento, ou seja, no componente que mede a compreensão após a leitura sentencial. A tarefa de leitura auto-cadenciada, a qual se constitui como uma tarefa online e que seria capaz de mensurar o processamento em tempo real, mostrou que sentenças qualitativas foram lidas mais lentamente quando seguiam um priming metafórico. Como previsto por Glucksberg e Keysar (1990) e por Gentner and Bowdle (2005), os efeitos de supressão em sentenças-alvo que acompanham um priming metafórico são suporte ao processamento de metáforas através da categorização. Neste sentido, diferenças estatísticas entre sujeitos de pesquisa com maior e menor controle inibitório, o qual foi aferido por meio de uma tarefa de Stroop, mostram que o mecanismo é relevante ao processamento de informações acompanhadas por metáforas. Em relação ao processamento de expressões licenciadas por metáforas conceituais (ex.: A discussão fez meu sangue ferver), os resultados encontrados foram similares àqueles das metáforas nominais (Ex.: O amor é um abacaxi) no que diz respeito ao papel do controle inibitório. Os tempos de reação ao ler as sentenças-alvo relacionadas a metáforas conceituais, no entanto, foi maior que aquele encontrado na leitura de metáforas nominais. O presente estudo traz contribuições para estudos sobre processamento metafórico, com evidências em favor do caráter de categorização da metáfora.

Palavras-chave: metáforas nominais. metáforas conceituais. controle inibitório. priming. processamento da linguagem.

Abstract

Inhibitory control is as an important component of human cognition, which is present in linguistic and non-linguistic processes. The present study attempts to investigate the role of inhibitory control (IC) when processing metaphorically primed targets. Participants read either a metaphorical prime sentence (e.g., Meu computador é uma lesma), a literal prime sentence (e.g. Lesmas são moluscos), or a baseline-prime sentence. Baseline-prime sentences were unrelated (e.g. Aquele rapaz é um doce). The literal prime sentence was changed into nonsensical sentences in half of the experimental sentences (e.g. Aquela garrafa é uma lesma). Reaction times for property statements relevant to the metaphorical meaning of the vehicle (e.g. Lesmas são lentas) were faster when participants read the metaphorical priming then the literal one. In contrast, reaction times were slower when the property statement was related to the basic literal meaning of the vehicle (e.g. Lesmas são moluscos). These results, however, were only found in the offline component of the experiment, that is, in the one which measured comprehension after the sentence was read. The self-paced reading task, which is an online task and is supposedly able to measure real time sentence processing, showed that property statements were read slower when they followed a metaphorical priming. As predicted by Glucksberg and Keysar (1990) and by Gentner and Bowdle (2005), the suppression effects in metaphorically primed targets support the processing of metaphors through categorization. In this sense, statistical differences between higher and lower IC groups, separated through participants results in a Stroop task, show that the mechanism is indeed relevant to the processing of metaphorically primed information. Regarding the processing of expressions licensed by conceptual metaphors (ex.: A discussão fez meu sangue ferver), we found that the results were similar of those of nominal metaphors (Ex.: O amor é um abacaxi) in relation to the role of inhibitory control. Reaction times for targets related to conceptual metaphors were higher for all participants, when compared to nominal metaphor related targets. This study contributes to the studies on metaphor comprehension, showing evidence that support the categorization account of metaphor understanding.

Keywords: nominal metaphor comprehension. conceptual metaphor comprehension. inhibitory control. priming. language processing.

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List of abbreviations and acronyms

EF	Executive Function
IC	Inhibitory Control
WMC	Working Memory Capacity
CF	Cognitive Flexibility
CMH	Career of Metaphor Hypothesis
TMC	Theory of Conceptual Metaphor
RT	Reaction Time
VLT	Vocabulary Levels Test
NCE	Negative Compatibility Effect
SPM	Standard Pragmatic Model
SD	Standard Deviation

1 Introduction

This chapter briefly introduces the topic of the present thesis, such as its purposes, objectives, research questions and experimental design.

1.1 Overview

Inhibitory control (IC) is one of the three cornerstones of the executive functions (EF's), which refer to a group of top-down, goal directed, mental processes (DIAMOND, 2013). Together with working memory capacity (WMC) and cognitive flexibility (CF), inhibitory control has been associated with performance in numerous cognitively challenging tasks (VALIAN, 2015; BIALYSTOK, 2015). While working memory capacity is related to the human capacity of manipulating stored information, inhibitory control is responsible for consciously and unconsciously suppressing information. At times, the suppression of certain pieces of data is what allows a more efficient processing of the input. WMC and IC are linked together with mental flexibility, which allows our minds to think of multiple ideas at the same time. Correspondingly, it has been suggested that the EF's are the tools that yield mental flexibility, making it possible for us to adjust our answers according to the given input (PARENTE; COLOSIMO, 2014). That is, thanks to the integration of WMC, CF, and IC, it is possible to accomplish goals in a flexible manner.

In their study regarding neural networks, Cohen and D'Esposito (2016) argue that the brain has the ability to reset its structure depending on the environment. That would mean that flexibility is not restricted to the functional level of the human mind, but would be extended to the structural aspect of the brain, since structural changes would be a consequence of neural networks being able to rearrange themselves (COHEN; D'ESPOSITO, 2016). One example of such change was reported by Maguire et al. (2006), who have found changes in the brain structure of taxi drivers as a consequence of the cognitive demands of their profession. Since taxi drivers need, not only to learn street names and addresses, but also to manipulate those pieces of information in efficient ways on a daily basis, the part of their brains related to those operations may have consequently increased. This study is specially relevant to prove that the human brain is molded by experience and that, by extension, the interaction with their surroundings has impact in one's mind. Also, given that each human being interacts with the world in their own unique way, and that that their respective neural connections go through an adaptation process that would dependent on experience, it becomes clear that IC, WMC and CF constitute individual human features.

An important concept closely related to executive functions is cognitive control,

which is of great importance in memory usage. It makes use of executive functions in order to fulfill goal-oriented tasks based on behavior monitoring instead of relying on unconscious responses (LUNA et al., 2013). In a study about category recognition, for example, Spitzer and Bäuml (2009) investigated the RIF (retrieval-induced forgetting) effect [1]. Participants were asked to study the items they were given, which belonged to certain categories (eg. colors, fruits, etc.). It was observed that it was harder for them to recall non-studied items in those categories than to recall items from non-studied categories. These results suggest that the forgetting of some elements may be induced by the retrieving of related information. Similarly, Chiu et al. (2010) tested undergraduate students prone to dissociative disorders [2] regarding non-intentional inhibitory control. It was expected that participants would easily inhibit all sorts of information, since suppression of one's own personality would be a symptom of this type of disorder. The results however, pointed to what the authors called a 'cognitive failure', since participants showed difficulty in inhibiting what should have been suppressed. Studies like these posit the view that mnemonic tasks are greatly influenced by the efficiency of cognitive control, as well as of inhibitory control.

Given that human cognitive processes are highly dependent on memory capacity and other cognitive functions, and that language processing is an example of such processes, it is reasonable to assume that executive functions are equally involved in language comprehension and production. According to Medaglia et al. (2015), language processing involves the linguistic system, as well as cognitive control and the right hemisphere of the brain. In regards to sentence processing studies, for example, the role of working memory capacity in solving structural and semantic ambiguities has been investigated, but remains a controversial issue (PICKERING; GOMPEL, 2006). Regarding metaphor processing, however, the roles of working memory and inhibitory control are much clearer (BEATY; SILVIA, 2013; CHIAPPE; CHIAPPE, 2007; COLUMBUS et al., 2015). inhibitory control too has shown to be one of the basic mechanisms needed in metaphor comprehension (GERNSBACHER et al., 2001). Even tough Gernsbacher et al. (2001) limited their study to linguistic metaphors, such as 'That lawyer is a shark'[3], and conceptual metaphors, such as 'That lawyer invested time in his lawsuit' were not included, the study managed to illustrate how important cognitive processes are for language use.

Lakoff and Johnson (1980) claim that metaphor usage is an important part of language and culture, since metaphorical expressions reflect, to some extent, the way we think and perceive the world. However, it is hard to grasp how they are computed

[1] The RIF effect refers to the experimental situation in which a participant is induced to remember a piece of information, leading to the suppression of related (but not momentarily relevant) information.

[2] Dissociative disorder is a psychopathology related to the the disconnection of a person's memory, thoughts or behavior and their sense of self. In traumatic situations, for example, a person could dissociate event-related memories in order to escape the pain (WANG, 2018).

[3] Linguistic metaphors in the form 'A is B' are also known as nominal metaphors and will be referred to by this nomenclature, in order to differentiate them from conceptual metaphors.

in our minds, since metaphor theories are hard to be tested in experiments. Given the broad use of metaphors across many languages, the nature of its processing demands should be studied in more detail, as to how cognitive mechanisms are involved in their comprehension and production and to how these mechanisms can support explanatory theories of metaphor.

1.2 Statement of Purpose

Metaphors are broadly used in daily-life communication (LAKOFF; JOHNSON, 1980) and have been of interest for many scientists in different fields. From neuroscience to cognitive linguistics, much has been discussed about how metaphors relate to culture and how conventional and novel metaphors are processed (CAVALCANTE; FERREIRA; GUALDA, 2016; BEATY; SILVIA, 2013). Cognitive linguistics seems to be particularly interested in investigating how metaphor clusters are constructed and used in discourse (KIMMEL, 2010). The discussion of how those metaphors are understood by the human mind, however, is secondary in most of the studies.

In fact, not many studies have focused on the use of executive functions, such as inhibitory control and working memory, in the comprehension and production of metaphors. Billig et al. (2018) have listed and reviewed experimental metaphor studies that focus on executive functions and that were produced between the years of 2003 and 2015. The authors have found seven relevant research papers on the matter, a very small number, specially if we consider the vast rising literature on metaphors, with many papers and books being published every year.

In this regard, the present study is an attempt to replicate the findings of Gernsbacher et al. (2001), who investigated the mechanisms involved in metaphor comprehension in English language speakers. However, our study has some relevant differences in comparison to it. Firstly, our research aims at Brazilian Portuguese speakers who are between 18 and 30 years of age. Secondly, Gernsbacher et al. (2001) focused on nominal metaphors in the form "X is a Y", while our study investigated nominal as well as conceptual metaphorical primings. Thirdly, since the authors reported the presence of enhancement and suppression mechanisms on metaphorical processing, our study tries to add to that with a Stroop task which intends to measure participants' control levels of these mechanisms. Lastly, Gernsbacher et al. (2001) made use of a judgment task, in order to observe the time participants needed to evaluate whether the sentences made sense or not. The present study, however, also makes use of a self-paced reading task, which allows us to take a closer look on the processing of sentence fragments and might yield a more precise analysis on the necessary time to process the *vehicle* of a given metaphor.

All in all, the present thesis intends to contribute to the field, by experimentally

studying the cognitive demands of this specific type of figurative language. Additionally, this research hopes to bring light to the debate on the comparison and categorization accounts of metaphor interpretation and its relation to what has already been discovered about human language processing.

1.3 Research Questions

Our hypothesis is that speakers with higher executive control will process incongruent target sentences [4] more easily than those with lower executive control. The questions that guide this research are as follows:

I Do Brazilian Portuguese speakers also display the same inhibitory control and selection effects as participants in Gernsbacher et al. (2001) depending on the priming stimuli presented to them?

II Do speakers with higher inhibitory control process targets that follow a metaphorical priming more easily than lower inhibitory control participants?

III Are the results for the nominal and conceptual conditions similar?

IV Is there evidence to support either the class inclusion theory of Glucksberg and Keysar (1990) or the career of metaphor hypothesis (BOWDLE; GENTNER, 2005)?

1.4 Objectives

This research aims at analyzing the metaphoric processing of young Brazilian university students through the priming paradigm [5] in order to investigate its relationship with the role of inhibitory control. This objective can be narrowed down to the following goals:

I Investigate whether the presentation of metaphorical primes impacts on the processing of the metaphor-related target sentences, as well as more the non-metaphorically related targets.

II Verify whether nominal metaphors ('A is B') and conceptual metaphors licensed expressions ('A discussão me ferveu o sangue') make similar demands on cognitive mechanisms.

[4] Incongruent targets are the ones that follow stimuli that elicit a different meaning from that of the priming sentence. Eg., a metaphoric priming ('That surgeon is a butcher') followed by a target that conveys the literal meaning of the vehicle ('That butcher is a good man') would be incongruent.

[5] The priming paradigm consists of presenting a stimulus to the participant, in order to investigate its impact on the processing of the target information. For that matter, the priming stimulus can be related or unrelated to the target.

III Verify whether high inhibitory control participants show better performance when processing metaphorical primings and metaphorically primed target sentences.

1.5 Thesis Organization

This thesis is divided into five distinct chapters, including the Introduction. In Chapter 2, we present the theoretical background we used to support our results. Chapter 3 concerns the methods and materials used in this research. Chapter 4 deals with the data analysis and interpretation of the results. In Chapter 5, we present a general discussion on our findings and on the limitations of the present study.

2 Theoretical Background

In this chapter we will present theoretical background concerning (i) the career of metaphor hypothesis, (ii) the class inclusion theory of metaphor, (iii) the conceptual metaphor theory, and (iv) inhibitory control.

2.1 Metaphor

According to the Standard Pragmatic Model (SPM) (GRICE, 1975; GRICE, 1978), figurative language is first interpreted by deriving the literal meaning of an utterance. Only when the derived meaning does not make any sense, the search for a possible non-literal meaning would start. In contradiction, studies have shown that figurative language is understood as rapidly as literal language, showing that literal information has no advantage over figurative language (GIBBS, 1983; KAPLAN, 1992). That is, both meanings would have the same chances of being given preference, since they would be computed in parallel.

Discussions on metaphor have yet raised another issue, of whether comprehension happens through comparison or categorization. The SPM poses that after discarding the literal meaning, metaphors would be interpreted as comparisons and implicit similes[6], which would be easier to understand (GRICE, 1975). However, this assumption was also proven to be false, since metaphors are neither easier to understand nor are they interchangeable with similes (GLUCKSBERG, 2008). As a consequence of these controversial issues, two relevant accounts have tried to understand how metaphors are computed: the categorization account and the analogy account.

The Class Inclusion Theory (GLUCKSBERG; KEYSAR, 1990) represents, in this context, the categorization account, in which metaphors are computed through the creation of *ad hoc* functional categories[7]. According to this theory, a metaphor would be computed as a class inclusion assertion, in which the target would become part of a functional category, for which the *vehicle* would be a prototypical member, as can be illustrated in 1.

1. My dad is a night owl.

In a metaphor such as (1) a category would emerge, for which *night owl* would be the prototype and *dad* would be a member. Also, many other people and animals can be

[6] Being an implicit simile means that a metaphor such as 'That surgeon is a butcher' would be interpreted as the simile 'That surgeon is like a butcher' and that both could be used interchangeably.

[7] These functional categories stand for the category that emerges from the metaphorical expression while a metaphor is interpreted.

members of this category, and its recurrent use in language can increase the aptness of a *vehicle*, leading to its conventionalization (GLUCKSBERG, 2008).

The Structure Alignment Model (GENTNER, 1988), on the other hand, represents the analogy account, in which *vehicle* and *target* mappings are aligned and projected to create meaning. Even though this model has not been created exclusively to explain metaphor understanding, the model has given some insights on how the mind deals with analogies. It has been argued that it is not possible to find similarities and differences between two things, unless their structure is symmetrically aligned (WOLFF; GENTNER, 2011). According to this account, after *vehicle* and *target* are aligned, inferences on the meaning of the *vehicle* are projected to the *target*. For example, the metaphor LIFE IS A JOURNEY projects to the *target* characteristics such as 'is long', 'has many stops', 'is full of challenges/adventures', etc. These structural mappings would, for example, be useful for understanding unfamiliar metaphors, since it poses a simple way of dealing with comparisons.

The discussion of whether metaphors are understood as comparisons or as categorizations was tentatively brought together by the career of metaphor hypothesis (CMH), which attempts to combine both accounts and to explain that depending on the situation, a metaphor might be computed either as a comparison or a categorization (BOWDLE; GENTNER, 2005). There might be, depending on the metaphor and the way it is perceived, a shift in the mechanism used for processing it, both of which would start simultaneously when receiving a metaphorical input (BOWDLE; GENTNER, 2005). The hypothesis suggests, for that matter, that new metaphors would be computed as comparisons, whereas conventionalized metaphors would be understood as categorizations. That is, a metaphor would be frequently prone to include its target into the category represented by the *vehicle*. Since all the relevant features would already be salient, it would not be necessary to go through a process of comparison in order to comprehend it.

The Class Inclusion Theory was thought of when designing the experiments of the present study and will be used to interpret the collected data, since checking the validity of the categorization account is one of our research questions. We keep an open mind, however, to the fact that, even though the stimuli used in the present study consists of high frequency metaphors, they are not necessarily conventional to all speakers of Portuguese. For this reason, we do not discard the possibility of unconventional metaphors being processed as comparisons.

2.2 Conceptual Metaphor Theory

Even though theories of metaphor interpretation, such as the aforementioned Career of Metaphor hypothesis, mostly focus on nominal metaphors, a metaphor does not

necessarily appear in the form 'A is (like) B', since most of the time it can be implied or interpreted from the context (GIBBS, 2017). Gibbs(2017 calls our attention to the fact that many metaphors work as a way of filling vocabulary gaps in a language, being used instead of lacking words and expressions. The author also argues that many of those metaphorical expressions may be difficult to express in a non-metaphorical way, which makes it difficult for people to decide whether they are metaphorical (GIBBS, 2017). It seems to me that metaphors are so integrated to natural languages that attempting to identify and categorize them through structural patterns would probably fail.

Since the publication of *Metaphors We Live By*, by George Lakoff and Mark Johnson in 1980, much has been discussed about the role of metaphors in human's reasoning. First of all, the authors argue that our conceptual system, the one we use to reason our way through the world, is metaphorical (LAKOFF; JOHNSON, 1980). According to them, the way people use language can be used as evidence, since the conceptual system is used both in communicating and in reasoning. One of the many examples that is shown in their book is the conceptual metaphor ARGUMENT IS WAR, which basically means that we use a more concrete concept (war) to help us understand a more abstract one (argument). That is, given the existence of a *source domain* (which is another name given to the *vehicle*) and a *target* domain, it is possible to map the relationship between them, in a way that the *target* can be understood in terms of the *source*. Lakoff and Johnson (1980) suggest that the conceptual metaphor exemplified above ARGUMENT IS WAR allows us to use licensed expressions such as those in (2) and (3), showing how our reasoning and thoughts are, to some extent, organized through metaphors.

2. He attacked all my arguments.

3. He has indefensible claims.

Lakoff (2008) reminds us of the existence of primary metaphors, originally studied by Joe Grady (1997). The kind of metaphor studied by Grady was a more basic kind, more related to how the human body interacts with the environment than to abstract conceptualization. Those metaphors were consequently called primary metaphors and are responsible for connecting one's physical sensations to abstract feelings. According to Lakoff (1980), ordinary life gives people similar physical experiences around the world, allowing human beings to have mostly the same system of primary metaphors. He suggests that the combination of different cultures with this system would be the reason for different metaphorical systems. In this sense, primary metaphors would constitute the common basis in our cross-culturally different conceptual systems.

Since conceptual metaphors have such an important role in language use, we chose to include them in our study. That is, our experimental stimuli consisted of not only

nominal metaphors[8], but also of conceptual metaphors. However, instead of using the actual conceptual metaphor, such as LIFE IS A JOURNEY, for example, we opted for using metaphorical expressions licensed by such metaphors, such as 'that man has passed away.' By doing this, we intended to investigate the Class Inclusion account for these licensed expressions, as for whether they create *ad hoc* categories when interpreted. Since licensed expressions are frequently used without people being aware of the implicit metaphor from which they are derived, we believe this kind of experimental stimuli would allow us to take a step closer to how metaphors are actually processed in communication.

2.3 Inhibitory Control

Executive functions are top-down mental processes that comprise inhibitory control (IC), working memory capacity (WMC) and cognitive flexibility (CF) (DIAMOND, 2013). IC relates to how our minds are able to suppress event-unrelated information in order to select what is relevant in both linguistic and non-linguistic contexts. A non-linguistic example of inhibitory control would be the ability to suppress a desire for candies while being on a diet, whereas a linguistic example would be our ability to suppress informal words at a job interview. Even in these simple examples, it is possible to say that suppression is not an easy mechanism to control, specially when it is done consciously. Besides, as an individual characteristic, IC early in life is an important predictor of life outcomes, that reaches its peak during teenage and adult life, and it declines with aging (DIAMOND, 2013). In regards to language processing, IC is often associated with WMC, which is 'where' all information is held and manipulated. WMC is, therefore, crucial for reasoning (DIAMOND, 2013), and consequently, for language use. Furthermore, Metaphors are often associated with creativity, especially when novel metaphors are created during communication (BEATY; SILVIA, 2013). The EF component responsible for creativity is CF, which develops later in life, when compared to IC and WMC (DIAMOND, 2013).

Cognitive scientists have been interested in both linguistic and non-linguistic applications of executive functions. Wiley and Jarosz (2012), for example, investigated the importance of attentional control and memory capacity in mathematical problem solving. The authors found that analytic problem solving makes use of working memory capacity, which carries its own mechanisms, such as attentional control. However, creative problem solving does not relate to WMC and can be impaired by domain-specific knowledge and attentional restrictions. Linck et al. (2012), on the other hand, observed the language switching performance in trilinguals. In a multilingual switching task that involved English, French, and Spanish, the authors found evidence of the connection between language IC and participants' performance in changing languages. Essentially, EF's play an important role in tasks that involve cognitive control, even if those tasks are not linguistic.

[8] Nominal metaphors are those in the form 'A is B'

In language comprehension, sentence parsing is known to depend highly on executive functions, specially on working memory capacity (CUNNINGS, 2016). Since working memory development is suggested to be partially attributed to IC (RONCADIN et al., 2007), we expect that, in this study, participants with a more developed IC[9] will consequently process the presented stimuli more easily than participants with a less developed IC.

2.4 The Replicated Study: Gernsbacher (2001)

The way humans use language has always been subject to philosophic contemplation, which extends beyond the relationship between language and thought (WITTGENSTEIN, 1958). Inquiries about this human faculty has also awaken scientific interest, not only in the theoretical approaches to language, but also in experimental investigations. One such study is here exemplified by the work of Gernsbacher et. al (2001), which was initially designed to test Glucksberg and Keysar's (1990) Class Inclusion Theory, in order to shed light on how humans process metaphors. Instead of making use of more traditional approaches, which understand metaphors as mere comparisons that only occur when a literal meaning is not available, the researchers took a step in testing for the relationship of metaphor understanding and our capacity of categorizing the world that surrounds us.

The main idea of Gernsbacher et al. (2001) was that, once a metaphorical input is received, it goes through a categorization process, for which a functional category is created on the spot. As members of this category there are both the *target* and the *vehicle*, with the *vehicle* being its prototypical member. For example, during the comprehension process of a metaphor such as 'that lawyer is a shark', a new category is created, which includes members that share the characteristic of *being a shark*. Once this category is created and, in case the context asks for it, it is possible to retrieve other members that would fit in such category. It is also possible to link those members together through a feature they share. In our example, one such feature would be the tenacity, shared by sharks and lawyers. Another example would be the metaphor "my brother is a peach". Its *ad hoc* functional category would have 'being a peach' as a shared feature, which, in the English language, only applies for people. For that reason, members of these category would be people who share the trait of being nice to others. Therefore, the process of interpreting a metaphor involves putting information together and culminates in categorizing this information into groups of members that share at least one feature.

The study itself relied on three different experiments, all of which made use of the priming paradigm[10], and presented both metaphorical or literal sentences as primes before

[9] Our experimental design controls both participants' IC and the facilitation/difficulty effects when they read the given stimuli.

[10] The priming paradigm is an experimental technique in which participants are exposed to a previous

participants read the actual experimental target property statements. Examples 4 to 8 below illustrate all possible primings and targets for the prototypical category of 'being a shark', as presented in Gernsbacher et al. (2001)[11].

4. That lawyer is a shark. (metaphorical priming)
5. That hammerhead is a shark. (literal priming)
6. That English book is a shark. (nonsensical priming)
7. That lawyer is tenacious. (metaphor-related target)
8. Sharks are good swimmers. (literal target)

Since the *vehicle* of a metaphor is an ambivalent word that could, depending of the context, display a literal or a metaphoric meaning, the study was designed to prove that metaphorical primings instances would be able to yield a facilitation effect on target sentences that displayed the functional feature of a metaphorical category. In a similar fashion, the study looked for difficulties in processing target sentences that were related to the literal basic meaning of the *vehicle* after the participant was exposed to a metaphorical priming. The premise was that, being exposed to the metaphorical meaning, its pre-activation would hinder the processing of a literal priming not related to the metaphorical meaning of the *vehicle*. That is, it was expected that after reading a priming like example (4), reading a target such as (8) would be more difficult than reading (7). Overall, the priming paradigm showed to be a reasonable technique to test the class inclusion theory.

The first experiment in Gernsbacher et al. (2001) aimed at logical priming stimuli, as exemplified in (4) and (5). At the end of each sentence, be it a priming or a target stimulus, participants pressed an answer key to the question of whether sentences made sense or not. The time taken to answer the question was interpreted as a measure of offline processing[12] and the mean reaction times for all target sentences were computed. Results showed a facilitation effect for congruent situations, such as (9) and (10), and difficulty effects for incongruent contexts[13], such as (11) and (12).

stimulus, called prime, being, afterwards, exposed to the target stimulus. When prime and target are related, the information that was pre-activated by the prime is expected to facilitate (or hinder, depending on the relation between both stimuli) the processing of target information.

[11] Even though many combinations of literal and metaphorical sentences can be extracted from the *vehicle* of a metaphor, our experiments only presented one pair for each of them, not using the same *vehicle* in more than one trial.

[12] To measure offline processing means to observe the participant's response times after the stimulus was totally processed and participants had some time to think before answering the given question.

[13] When the priming sentence was metaphorical, the congruent property statement would be the one that elicit the metaphoric feature of the functional category, whereas the incongruent target would be the one that elicit the basic literal meaning of the *vehicle*. When the priming was literal, on the other

9. That lawyer is a shark. (metaphorical priming)
   That lawyer is tenacious. (metaphor-related target)

10. That hammerhead is a shark. (literal priming)
    Sharks are good swimmers. (literal target)

11. That lawyer is a shark. (metaphorical priming)
    Sharks are good swimmers. (literal target)

12. That hammerhead is a shark. (literal priming)
    That lawyer is tenacious. (metaphor-related target)

The priming-target pairs in (9) and (10) illustrate congruent stimuli, since sentences are both either metaphoric or literal. On the other hand, the pairs in (11) and (12) represent incongruent stimuli, because when the priming is metaphorical, the target is literal, and vice-versa. Gernsbacher et al.(2001) suggest that the facilitation effect found in trials such as (9) and (10) and the suppression effect found in trials such as (11) and (12) would be evidence for the creation of functional categories in metaphorical processing.

Since the *vehicle* of the metaphor and the subject of the property statement (*target*) were the same in experiment 1, in experiment 2, in order to confirm that the observed effect was not due to lexical priming, targets were changed into nonsensical ones. That is, the experimental metaphorical primings should raise metaphorical interpretation, but present a lexical entry for the *vehicle* different from that of subject in the *target* sentence. For this part of the experiment, the study showed the same pattern of experiment one, which indicates metaphoric interpretation happens even when the input is nonsensical, with the target of an illogical metaphor included in the same category as its *vehicle*. These results also support the creation of an *ad hoc* category that includes *target* and *vehicle*.

The third experiment was used as a reference, since *primes* and *targets* were unrelated and did not, therefore, yield facilitation or difficulty effects. It was observed that reaction times for unrelated targets were much higher. For me, this could indicate the existence of a facilitation effect even in incongruent contexts, which might be explained by the fact that sentences are connected by the multiple meanings of the *vehicle*.

Our study aims at replicating Gernsbacher et al. (2001), but with some methodological changes(see Chapter 1 for details), in an attempt to add new insights to the field, such as the impact of IC and the processing of conceptual metaphors as opposed to nominal metaphors. Similarly to Gernsbacher et al. (2001), nevertheless, our study shares an interest in testing the class inclusion theory of metaphor (GLUCKSBERG; KEYSAR, 1990) through the priming paradigm.

hand, the congruent target would be the basic level property statement and the incongruent one would be the one related to the metaphorical feature.

3 Methods and Procedures

In this chapter we will present the participants' profiles, the materials, methods, and procedures used in this study.

3.1 Method

The present study follows an experimental within-subjects design. In this kind of design, participants are exposed to all conditions of the experiment, in opposition to the between-subjects design. In the latter, participants are divided into two groups, who perform different tasks in a study. Since this separation is most of the time random, results may be influenced by uncontrolled individual traits. In the former, on the other hand, since participants are able to take part in all conditions, the effects of individual characteristics over the results are more balanced and show a more sensitive measure of the independent variable (MILLER, 1984). Our experiment consisted of two different tasks: a Stroop task and a self-paced sentence-reading task. The independent variables are namely the native language of the participants (Brazilian Portuguese) and the types of sentences used in the trials. The dependent variables, on the other hand, refer to the judgment of the sentences, the reaction times (RT's) for the self-paced reading task, and the reaction times (RT's) for the Stroop task.

Following the chosen experimental design, all participants took part in both tasks: the Stroop Color and Word Test (SCARPINA; TAGINI, 2017) and the self-paced reading task. The first task consisted of naming the ink color of the presented words and is designed to measure the IC of participants through their performance in incongruent trials. Figures 1 and 2 illustrate the congruent and incongruent trials.

Since the brain of a literate person is conditioned to reading when exposed to

Figure 1: Congruent context in the Stroop Test of Words and Colors (word in red)

Figure 2: Incongruent context in the Stroop Test of Words and Colors (word in red)

the written word, which could designate either a color or an object, it is expected that participants will be able to suppress the read information and only focus on the colors they see in the display. That is, participants are invited to press the correspondent colored-button as fast as they can, with lower inhibitory control participants taking more time to suppress the word they see.

The second task is designed to observe how fast participants are able to read critical words in a sentence[14]. Each trial consisted of a pair of priming-target sentences, which were read fragment-by-fragment. Each fragment consisted of a word, and participants should press the space button on the keyboard in order to go from one fragment to the next. Both the priming and the target sentences were read in this self-paced mode, and were followed by a question of whether the sentence was meaningful. For all the sentences, the critical word was set in the fifth position, and, in the case of metaphorical sentences, they would be represented by the *vehicle* of the metaphor. A yes-no question followed each sentence, so that we would be able to measure participants' offline RT's.

As for the data analysis, a Python script was used, as well as Excel®[15]. The use of both tools was necessary, since each one of them have practical features that could be explored in order to optimize our analysis. Python was used to extract the data of each participant and prepare it for statistical analysis in Excel. Since the design for our experiment is complex and has many conditions[16], the results were divided systematically. First, the analysis for the Stroop task will be presented and will aim at separating participants into a higher and a lower IC groups. Second, the analysis for the nominal metaphors, followed by the analysis of the conceptual metaphors will be shown. Third the analysis of the baseline sentences will be presented. Fourth, the analysis for the priming sentences will be carried out. And, at last, we will present the analysis for the follow-up

[14] The self-paced reading task is an example of an online task, which allows us to observe how fragments of a sentence are processed, in contrast with offline tasks, in which we can only observe the result of such processing.

[15] Excel was used for statistical analysis together with a free add-in resource pack named Real-statistics®, which can be found at <www.real-statistics.com>

[16] There are four conditions for nominal metaphors and four (the same) for the conceptual metaphors.

questions. For each of these parts, our analysis will compare the performances of higher and lower IC groups in order to analyze and contrast the possible impacts of both the inhibitory control and selection in the processing of the experimental sentences.

On the whole, the experiment described in this thesis intends to shed some light on the way people process metaphorical sentences and the effects of metaphorical priming sentences to the understanding of either subsequent literal or figurative sentences. In order to do that, we intend to replicate Gernsbacher et al. (2001).

3.2 Participants

Participants were graduate and undergraduate students from the Federal University of Minas Gerais, who received an email invitation to respond to an online questionnaire (which can be found in the appendix) and voluntarily accepted to be contacted for the scheduling of an experimental session. The questionnaire was composed of questions regarding participants' personal information, which might be of relevance to further research on language and cognition studies. For the present study, information on participants age, neurological disease background and visual acuity were used. This means participants should not be older than 30 years of age, should not have been diagnosed with any neurological diseases and have normal or corrected-to-normal vision. Some of the participants applied to receive extra credits for their participation in this study and all of them freely signed an informed consent form (in Portuguese, the TCLE, which can also be found in the appendix).

Besides analyzing participants answers to the questionnaire in order to include them in the data analysis, other requirements were set. Participants should have answered at least 66% of the Stroop task, as well as 66% of the self-paced reading questions correctly in order to be considered in the analysis. The 66% rate was chosen for being the same used in the study we aim to replicate and for lowering the probability of inattentive participants to be taken into account. Out of the 84 participants who took part in the experiment, 30 did not meet the agreed upon requirements for our within-subject analysis. At the end of the study, the total number of participants was 54.

Because studies show that the contact with foreign languages influences the RT's in Stroop tasks (VALIAN, 2015; BIALYSTOK et al., 2009), we have tried to run the experiment with participants who do not know any languages other than Portuguese and whose knowledge of with English is very basic (namely, VLT[17] level 1), but the attempt was unsuccessful. However, these participants are a few exceptions among the majority of young undergraduate and graduate students who displayed interest in taking part on

[17] VLT is a psychometric test to check the participant's proficiency level at a given language. For more information, check NATION (1990) and SILVA (2016).

this research, most of which allegedly know at least one foreign language. As I see it, as Brazilian universities attempt to intensify internationalization, students have started perceiving the learning of a second language as a requirement for their academic and professional lives.

Therefore, instead of focusing on participants' foreign languages and its potential relation to their executive functions, we focused on designing an experiment which would test their mother tongue. The experimental sentences were assembled using high frequency metaphors and lexical items[18], so that they would sound familiar to Brazilian native speakers. Even though there was the possibility to norm the metaphors prior to the running of the experiment, we opted for a using a web corpus, composed by formal and informal utterances of Brazilian Portuguese speakers on the internet in order to check those frequencies.

3.3 Materials

For this study, the software named Psychopy®[19] was used to run the experiments, which was presented to the participants in a 20-inch computer screen. Participants were invited to attend to the experimental session at the Psycholinguistics Laboratory at the Federal University of Minas Gerais. After taking part in the Stroop task, participants did the self-paced-reading task, at the same room and on the same computer. The time needed for the completion of both tasks was about 20 minutes.

3.3.1 The Stroop Task

Participants were given a keyboard with buttons labeled in three different colors: blue, red, and green. The task consisted in silently reading 72 colored words on the screen and pressing the correspondent color on the keyboard. Out of the 72 words, 16.67% were incongruent instances between color and word. Before starting the actual task, participants were given some time to practice and to get used to the keyboard. The practice session consisted of a smaller set of stimuli similar to the actual task, in which participants had to press the correspondent color on the keyboard. For this practice session, participants received feedback on each of the 16 trials, so that they could better understand the task. After finishing practice, participants started the actual task, in which no feedback was given, so that their attention would not be disturbed by eventual mistakes.

[18] While assembling the stimuli, we checked for critical words frequency on <https://www.corpusdoportugues.org/web-dial/>

[19] The free open source software can be found at: <http://www.psychopy.org>

3.3.2 The Self-paced Reading Task

In the second part of the experiment, participants' task was to silently read 110 sentences, word by word. Among these sentences were 32 experimental sentences [20], 32 baseline sentences[21] and 46 distractors. Each experimental pair consisted of a prime, which could be either a metaphorical or a literal sentence and a target, which was always a property statement. The property statements could, therefore, convey a meaning related to the literal or metaphorical meaning of the vehicle. All experimental pairs had the same syntactic structure of their correspondent baseline. As for the experimental sentences, 16 pairs were based on nominal metaphors and the other 16 were conceptual metaphors licensed expressions. After reading each sentence, participants were asked whether the sentence made sense, and should press either the yes-labeled or the no-labeled button, according to their intended response.

In regards to the nominal metaphor-related experimental sentences, the primings and the targets followed a regular pattern and were all formed by TOPIC + COPULA + VEHICLE + ADDITIONAL PHRASE (either an adverbial or adjectival phrase), as can be seen in the examples (13) and (14) below. Even though the additional phrase was not present in Gernsbacher et al. (2001), it accounts for the *spillover*[22] effect that may happen on self-paced reading tasks. The critical word is underlined in target (14).

13. prime: O amor | é | um abacaxi azedo | para muita gente.
    (Love is a sour pineapple to many people.)

14. target: O abacaxi | é | uma <u>fruta</u> tropical | bastante saborosa. (Pineapple is a fairly tasty tropical <u>fruit</u>.)

There were, for the priming-target combinations, such as in Gernsbacher et al. (2001), four different possibilities of combinations for the same vehicle of a metaphor: (a) a literal priming and a target related to the metaphorical meaning of the vehicle, (b) a metaphorical priming and a target related to the metaphorical meaning of the vehicle, (c) a literal priming and a target related to the literal meaning of the vehicle, and (d) a metaphorical priming and a a target related to the literal meaning of the vehicle. Such combinations were carefully controlled, so that no metaphor was repeated during the trials.

[20] 8 experimental sentences (4 pairs) were discarded prior to the data analysis. The reason was the realization that these pairs had the same combination of previous pairs and were, therefore, redundant to our study.

[21] Baseline sentences consist of stimuli that are structurally similar to the experimental sentences, but whose primings and targets are unrelated. That is, no facilitation or suppression effect is to be expected, and these stimuli are supposed to work as a reference point to our experimental results.

[22] The *spillover* effect refers to delayed difficulty effects in self-paced reading, which appear in subsequent words instead of the critical one.

In table 1, it is possible to see examples of sentences that were assembled for the experiment and the expectations we had based on the results from the study we aimed to replicate. An inhibitory effect would be expected when the conveyed meaning of the vehicle in the priming sentence is inconsistent when compared to the meaning it conveys in the target stimulus. A facilitation effect, on the other hand, would be expected when these portrayed meanings were consistent with each other. In other words, when a metaphorical priming is followed by a metaphor-related target, there would be a selection effect. Whereas if the following target is literal, the effect would be an inhibitory one. A similar table was initially made for every metaphor in this study and they were later modified to fit the technical and methodological demands of the present study. The final version for each pair of sentences used can be found in the Appendix.

Expected Effect	Metaphorical Priming	Target
Inhibition	O amor é um abacaxi. (Love is a pineapple.)	Abacaxi é uma fruta. (Literal) (Pineapples are fruits.)
Selection	O amor é um abacaxi. (Love is a pineapple.)	Abacaxis são azedos. (Metaphor-related) (Pineapples are sour.)
Expected Effect	**Literal Priming**	**Target**
Inhibition	Aquele abacaxi está fresco. (That pineapple is fresh.)	Abacaxis são azedos. (Metaphor-related) (Pineapples are sour.)
Selection	Aquele abacaxi está fresco. (That pineapple is fresh.)	Abacaxi é uma fruta. (Literal) (Pineapples are fruits.)

Table 1: Early experimental sentence combinations for nominal metaphors

In regards to the conceptual metaphor pairs, they followed a similar structure when compared to that of the nominal metaphors. Even though it was not possible for the priming sentences to follow the TOPIC + COPULA + VEHICLE + ADDITIONAL PHRASE-pattern of the nominal sentences, all target sentences were built to fit this structure. As for the primings, they followed a more flexible format with SUBJECT + VERB PHRASE + ADDITIONAL PHRASE. An example of this type of experimental pair can be seen in (15) and (16) below. The critical word is underlined in target (16).

15. priming: Cemitérios | faziam seu sangue congelar | à noite.
    (graveyards made his blood freeze at night.)

16. target: O lugar | estava | extremamente <u>frio</u> | no inverno.
    (the place was extremely <u>cold</u> in winter.)

As we did for the nominal metaphors, we first prepared a table with the four possible combinations for each conceptual metaphor in the experiment. An example can be seen in table 2.

Expected Effect	Metaphorical Priming	Target
Inhibition	Aquele prefeito fazia seu sangue ferver. (That mayor made her blood boil.)	A temperatura era alta. (Literal) (The temperature was high.)
Selection	Aquele prefeito fazia seu sangue ferver. (That mayor made her blood boil.)	O rapaz estava nervoso. (Metaphorical) (The boy was angry.)
Expected Effect	**Literal Priming**	**Target**
Inhibition	Aquele calor fez a água evaporar. (That heat made the water evaporate.)	O rapaz estava nervoso. (Metaphorical) (The boy was angry.)
Selection	Aquele calor fez a água evaporar. (That heat made the water evaporate.)	A temperatura era alta. (Literal) (The temperature was high.)

Table 2: Early experimental sentence combinations for conceptual metaphors

The combinations were then controlled, in order not to repeat the same metaphor twice, just as was done for the nominal metaphors. Since reading a stimulus related to a previously read metaphor could yield an unwanted facilitation effect, only one combination of priming-target was chosen from each table (eg. table 2). Similarly to the assembly of nominal metaphor experimental pairs, in the case of conceptual metaphors, too, the early versions of the stimuli was adapted to fit the software and methodology used, which is why the early version of table 2 lacks the additional adverbial/adjectival phrases that were added to the trials.

Besides the aforementioned combinations for the both types of metaphors we aimed to study, more experimental pairs were later created and transformed into nonsensical sentences, just as in the study we are replicating (GERNSBACHER et al., 2001). In total, the *vehicles* of 50% of the metaphors were turned into sentences that would not make any sense. Sentences (17) and (18) below exemplify the nonsensical nominal metaphor primings and targets.

17. priming: Aquela foto é um armário desde a semana passada.
    (That photo is a cupboard since last week.)

18. target: Armários são belos móveis grandes de madeira.
    (cupboards are big beautiful pieces of furniture out of wood.)

Additionally, examples (19) and (20) illustrate the nonsensical conceptual metaphor stimuli.

19. priming: Aquele tomate sempre lhe fervia o sangue à noite.
    (That tomato always made his blood boil at night.)

20. target: A temperatura era bem alta durante a madrugada.
    (the temperature was really high through the night.)

It is important to note that in all critical pairs, target sentences were always a property statement that made sense. Also, the vehicles in the priming sentences were

always 3 syllables long and occupied the 5th position in the sentence. In (17) it is possible to see the critical word *armário* (in English, 'cupboard') in this position. Similarly, the relevant property-related words in the target sentences were 2 syllables long in all the trials and could also be found in the 5th position, such as *grandes* (in English, 'big') in the property statement (18).

3.4 Procedures

Participants were tested individually in a room designed for collecting behavioral data. In the room, which is approximately 1.5 square meters big, there was a computer monitor and keyboard with specific keys indicated with colored labels, as well and yes-no buttons.

At the beginning of the Stroop task, participants read the instructions on the screen and followed them in order to begin their practice. They were told that they would see colored words on the screen and that they should press a key that corresponded to the color they saw. Participants were also instructed to make use of their dominant hand to answer the trials, and for that, their index and middle fingers were used. In the practice session, participants answered to 16 words and feedback was given, so that participants knew if they were doing the task correctly. Participants were accompanied during training and were asked if there were any questions before proceeding to the real task. Fixation times were 40 milliseconds before the appearance of words and the time limit for pressing the colored button was 6 seconds or until the participant pressed a key.

Similarly to the Stroop task, for the experimental task, participants read the instructions on the screen and followed them into their practice session. They were instructed to use the space button to read through the sentences. When pressing the space button, the previous word disappeared and the next one appeared. After reading the whole sentence, participants had to answer a yes-no question using either the yes-labeled key or the no-labeled key. During the instructions, participants read 8 different sentences, which exemplified both the logical and the nonsensical kinds of sentences presented in the actual task, and they also answered to the follow-up questions, for which they received feedback on their responses. Participants were asked whether they had questions regarding the experiment and proceeded to the task after having their questions cleared. During the actual task, no feedback was given. Fixation times for this task were also 40 ms before the appearance of the first word and the time limit for pressing the yes-no keys was 6 seconds before being automatically presented with the next sentence.

All sentences appeared in the center of the screen and the letters initially appeared as consecutive *hyphens*. In order to distract participants from guessing the purpose of the experiments, some of the distractor stimuli were followed by a distractor question of

whether the sentence contained a specific word. Figure 3 below shows how participants first saw a distractor-like sentence in the practice trial and figure 4 shows the follow-up question to the stimulus.

Figure 3: Sentence: 'Teachers work in restaurants'

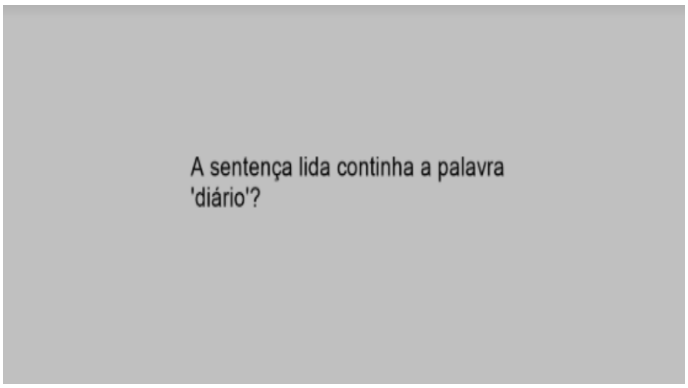

Figure 4: Question: 'Did the sentence contain the word 'diário' (journal)?'

Figure 4 above illustrates how participants were presented with the distractor follow-up question to the sentence in Figure 3. Distractor follow-up questions were used after some of the distractor sentences, but not in the critical stimuli. All critical stimuli were followed by the question: "does this sentence makes sense in the real world?"

All in all, our study relies in two experiments: the Stroop task and the self-paced reading task. The first aims at controlling the IC of our participants, while the second aims at investigating whether metaphors are processed through categorization. In order to do that, sentences were controlled, so that the response time for the critical word in each sentence could be analyzed. Since metaphor processing is said to make use of executive functions (GERNSBACHER et al., 2001; BEATY; SILVIA, 2013), we expect that participants with higher inhibitory control will more easily process congruent and incongruent targets.

4 Results and Discussion

This chapter aims to present (i) the statistical data analysis, (ii) its results, and (iii) the partial discussion for each session.

For every subsection of this chapter, the statistical analysis will be followed by inferential analysis. Initially, the Shapiro-Wilk test was conducted in order to check for the normality of the data. Since the data distribution was not normal, non-parametric tests were used in the analysis. The Mann-Whitney Test for Two Independent Samples was used in the analysis of the Stroop Task. As for the the Self-paced Reading task, the Wilcoxon for Paired Samples was used for within group analysis, while Mann-Whitney was used for between groups. The results for each experimental sentence can be found in the Annex.

4.1 The Stroop Task

The Stroop task aims to demonstrate how fast a participant is in suppressing irrelevant information and pressing a key after being exposed to an incongruent stimuli. The importance of this kind of task lies on the fact that it sheds light onto one's capacity of manipulating information in the mind, which relates both to the executive control needed for suppressing unnecessary information and to the ability to process information and select the right response in incongruent trials.

Accordingly, participants' RT means for the incongruent trials were taken as an indication of their inhibitory control and were used for separating them into a higher and a lower level groups. The two groups were separated by the median of the distributed means of all participants. Table 3 below presents the SD and the mean for each group, which we will call group A (higher IC) and group B (lower IC).

Incongruent Context (RT's)	Mean	SD	Median
Higher Level (Group A)	657 ms	15 ms	654 ms
Lower Level (Group B)	1.03 secs	37 ms	989 ms

Table 3: Stroop Task Results

The Shapiro-Wilk test was chosen to test if the RT's were normally distributed and a p-value was fixed in order to reject the null hypothesis. The test showed that the data was not normally distributed (W=0.91, p. = 0.0006). We then analyzed the data with

the non-parametric Mann-Whitney Test for Two Independent Samples in order to test whether the groups were statistically significant. The test showed a significant difference between the two groups, p. = 3e-10.

4.2 The Self-paced Reading Task

For the self-paced reading task, reading times were computed only for the fifth word of each property statement, which represent the critical words of each stimulus. The critical words for the property statements (targets) could either relate to the metaphorical or the literal meaning of the vehicle. In priming sentences, the critical word consists of a conventional vehicle, being used as either its literal or its metaphorical meaning.

After running Shapiro-Wilk on participants' reading times for all sentences, it became clear that not all the data for groups A and B was normally distributed. For that reason, the non-parametric Wilcoxon Signed-Rank Test for Paired Samples was chosen to test the statistical relationship within groups and the Mann-Whitney Test was selected for analyzing differences between groups.

In order to facilitate the understanding of the data, we named metaphorical primings and literal primings as they are, since our stimuli consist of these two types of sentences. As for the targets, sentences were always property statements in non-figurative speech that could relate either to a metaphorical meaning or a literal meaning regarding the subject. For that reason, we called the latter 'literal targets' and the former 'metaphorical targets', even though the labels might be misleading at a first glance. That is, both targets consist of a subject and an adjective connected through a copula verb, with the adjective relating either to the metaphoric or to the literal meaning of the vehicle.

Sentence (21) below exemplifies one of our metaphorical primings, while (22) and (23) illustrate its metaphor-related and literal-related meanings.

21. Meu computador é uma lesma. (my computer is a snail) [23]
22. Ele é devagar. (it is slow)
23. Ele é gosmento. (it is gooey)

4.2.1 Nominal Metaphor Analysis

When comparing both groups overall performance for the nominal metaphor conditions, group A showed, as would be expected, a faster response (M = 464 ms, SE = 0.03) than group B (M = 537 ms, SE = 0.047) when reading primings and targets together

[23] In Portuguese, 'being a snail' means to be slow.

(U=20086, p.=0.012). However, when observing the groups' performances on each of the four conditions, no statistical significance between both them were found. Figure 5[24] shows group A and B participants' reading time means for nominal metaphors in all four combinations.

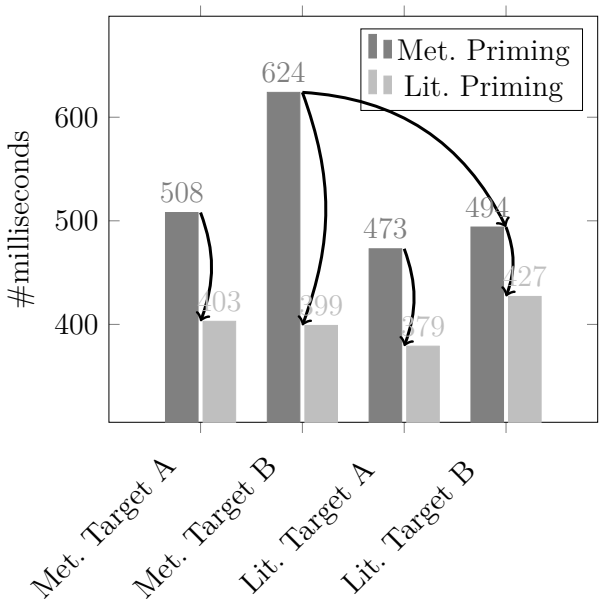

Figure 5: Target response times for groups A and B in the nominal metaphor condition.

On the one hand, group A participants were faster to read the congruent literal target (M = 379 ms, SE = 0.018) when compared to the incongruent one (M = 473 ms, SE = 0.026), p = 1.6e-5. Unexpectedly, when the target was metaphorical, however, participants were faster to read the incongruent (M = 403 ms, SE = 0.027) than congruent targets (M = 508 ms, SE = 0.03), p = 0.001.

On the other hand, group B participants were also slower to read the incongruent literal target (M = 494 ms, SE = 0.036) in comparison to the congruent one (M = 427 ms, SE = 0.028), p = 0.005. When the target was metaphorical, similarly to group A, participants were faster to read the incongruent sentences (M = 399 ms, SE = 0.014) instead of the congruent ones (M = 624 ms, SE = 0.066), p = 6.4e-7. Additionally, the effect of metaphorical priming over the processing of both types of targets was also found statistically significant for this group, with participants processing the incongruent (M = 494 ms, SE = 0.036) faster than the congruent target (M = 624 ms, SE = 0.066), p = 0.006.

[24] Statistical significance between and within groups is shown on the graph through arrows.

These results show three unexpected outcomes. First, there was no facilitation effect for the congruent metaphorically primed target, as would be predicted by the class inclusion theory. Second, there was also no facilitation effect for the congruent literally primed target either. Third, both groups processed incongruent metaphorical targets faster than congruent ones, when the opposite was expected. At a first glance, it is possible to affirm that the self-paced reading task failed in replicating Gernsbacher and colleagues' results.

4.2.2 Nonsensical Nominal Metaphor Analysis

As for the reaction times in the nonsensical condition, there was no significant difference between groups, even though group A participants showed, overall, a faster response (M = 485 ms, SE = 0.041) than group B participants (M = 501 ms, SE = 0.0423) when reading the stimuli (U=22110, p.=0.348).

Figure 6 shows group A and B participants' reading time means for nonsensical nominal metaphors.

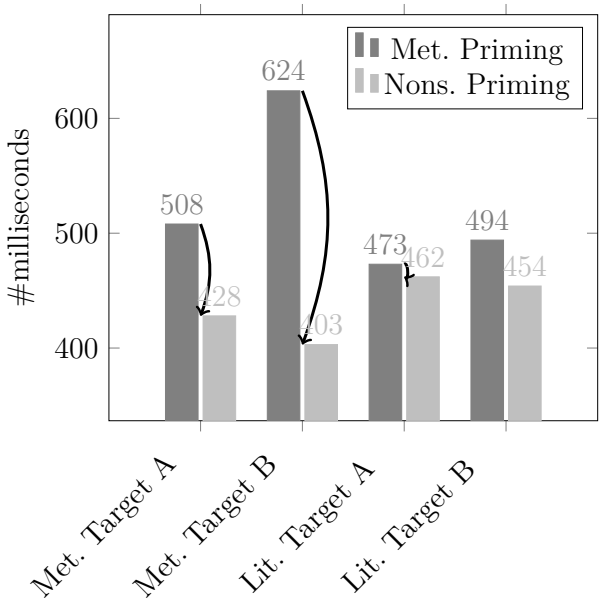

Figure 6: Target response times for groups A and B in the nonsensical nominal metaphor condition.

When looking at each of the four conditions too, no statistically significant differences between groups were found. Differences were only found when observing the conditions within each group separately.

Group A participants were faster to read the congruent literal target (M = 462 ms, SE = 0.62) in comparison to the incongruent one (M = 473 ms, SE = 0.026), p = 0.014.

On the other hand, these participants were slower to process the congruent metaphorical target (M = 508 ms, SE = 0.03) when compared to the incongruent one (M = 423 ms, SE = 0.028), p. = 0.025. Again, having participants process congruent trials slower than incongruent ones is a result we did not foresee. However, Group B participants showed similar reading times, being slower to read the congruent metaphorical target (M = 624 ms, SE = 0.066) when compared to the incongruent metaphorical target (M = 494 ms, SE = 0.02), p = 1.1e-5.

Even though unexpected results have surfaced, they are aligned with those from the nominal metaphor condition, for which metaphorical targets also yielded no facilitation in congruent trials. Interestingly enough, literal targets delivered the expected results in both logical and nonsensical trials.

4.2.3 Conceptual Metaphor Analysis

Regarding conceptual metaphors, there were some significant differences in relation to the nominal metaphor trials. As expected, group A showed a faster response (M = 547 ms, SE = 0.042) than group B (M = 630 ms, SE = 0.051) when reading primings and targets in the conceptual metaphor condition (U=18288, p.=9.6e-5). Apart from the fact that reading times for group A was significantly faster than for group B, there were also some differences regarding statistical significance.

Figure 7 shows group A and B participants' reading time for conceptual metaphors.

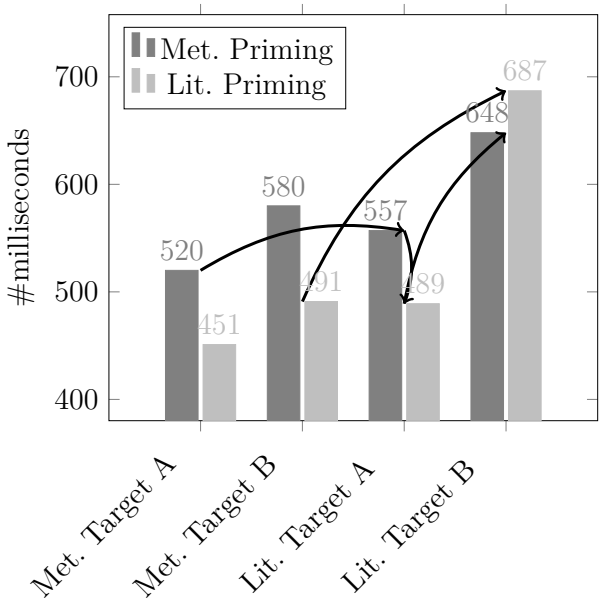

Figure 7: Target reading times for groups A and B in the conceptual metaphor condition

In this condition, statistical significance between both groups was found. Group A participants showed faster reading (M = 489 ms, SE = 0.032) than group B (M = 681 ms, SE = 0.057) for the congruent literal target (p = 0. 0087). For the other conditions, however, no statistically significant differences were found when comparing the groups. Still, within each group, new information came to light.

Within group A, participants were faster to read the congruent literal target (M = 489 ms, SE = 0.032) than the incongruent one (M = 557 ms, SE = 0.031), p = 0.008. Besides, statistical significance was found on the impact of the metaphorical priming over the target. When the priming was metaphorical, participants were faster to read the congruent targets (M = 520 ms, SE = 0.044) than incongruent ones (M = 557 ms, SE = 0.031), p = 0.039. As for group B, the effect of literal priming over the processing of both types of targets was found statistically significant. Participants processing the incongruent target (M = 681 ms, SE = 0.057) slower than the congruent one (M = 491 ms, SE = 0.035), p = 0.002.

Differently from nominal metaphors trials, there was no significant difference between the two metaphorical primings in the conceptual metaphor ones. Instead, the groups showed that primings influenced target reading, with group A being influenced by the metaphorical primings and group B, by literal primings.

4.2.4 Nonsensical Conceptual Metaphor Analysis

Again, in the nonsensical conceptual metaphor conditions, group A participants showed a faster response (M = 486 ms, SE = 0.034) than group B participants (M = 563 ms, SE = 0.044) when reading primings and targets (U=19019, p.=0.00087). Group A and B participants' reading time means for nonsensical conceptual metaphors can be seen in the graph of figure 8.

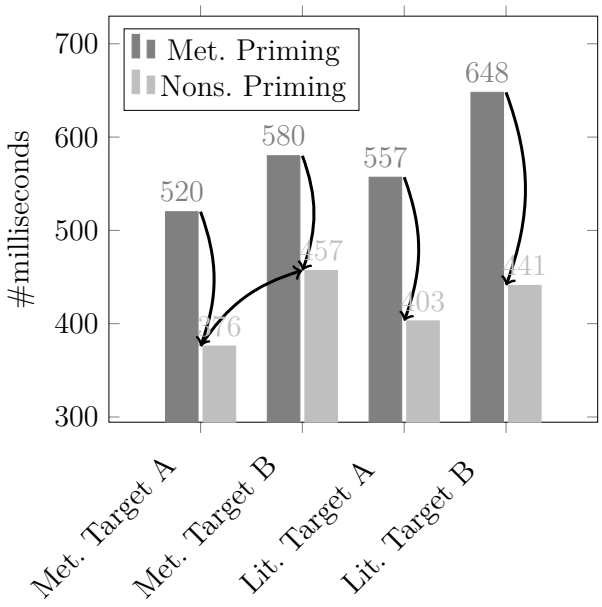

Figure 8: Target reading times for groups A and B in the nonsensical conceptual metaphor condition

Apart from the fact that a significant difference between groups was found for the nonsensically primed target, p. = 0.05, with group A (M = 376 ms, SE = 0.031) showing a faster reading time than group B (M = 457 ms, SE = 0.028), the nonsensical conceptual metaphor conditions were very similar to those of nonsensical nominal metaphors.

First, within group A, participants were, again, faster to read the congruent literal target (M = 403 ms, SE = 0.021) than the incongruent one (M = 557 ms, SE = 0.031), p = 1.6e-6. On the other hand, these participants were slower to process the congruent metaphorical target (M = 520 ms, SE = 0.044) than the incongruent one (M = 376 ms, SE = 0.019), p. = 0.0005. Second, within group B, participants were faster to read the congruent literal target (M = 441 ms, SE = 0.028) than the incongruent one (M = 648 ms, SE = 0.031), p = 3.7e-7. Besides, these participants were faster to process the congruent metaphorical target (M = 580 ms, SE = 0.045) than the incongruent one (M = 457 ms, SE = 0.037), p. = 1.6e-6.

The results for the nonsensical conceptual trials are consistent with the nonsensical nominal metaphors, in which logical metaphorical priming have a bigger impact (processing takes longer) on metaphorical targets than either nonsensical metaphorical primings or literal primings.

4.2.5 Discussion

Our results for the self-paced reading task were not compatible with our expectations. Firstly, there were no group differences for either the nominal nor the conceptual metaphors, be it in the logical or the nonsensical treatments. Secondly, metaphorical targets took longer to read, even in the congruent conditions, which contradicts our priming-effect predictions.

It is possible that the lack of facilitation effect in congruent metaphorically primed targets was influenced by the goal-oriented aspect of the task. Since participants knew there would be a yes-no interpretation task at the end of the sentence, they might have needed more time for deciding whether the metaphor-related word made sense in the context or not. Because most nonsensical sentences they were exposed to could actually make sense in a contextualized situation, participants might have been looking for tricky meanings in the metaphorically primed targets. However, we did take this into consideration and added distractor follow-up questions to the experiment, which makes this cause unlikely.

Even though these results are unexpected, a negative compatibility effect (NCE) is not unheard of, and consists on negative priming effects in congruent situations (SUMNER, 2008), such as ours. In fact, the NCE has been commonly found in masked-priming research and many researchers have attributed it to the automatic motor inhibition that would be triggered by the priming in order to suppress the motor activation caused by it (SUMNER, 2008). However, our results show that there are no significant differences between groups A and B in the metaphorically primed trials, which would suggest that inhibition is not the main cause of this effect. An alternative explanation would be that perceptual interactions between the prime the mask would cause a positive priming in the opposite direction (VERLEGER et al., 2004; SUMNER, 2008). Despite the fact that our experimental design does not make use of masked primings, we suggest that the existence of interactions between the primings and follow-up question (which invites participants to think about the sentence they just read) would produce a negative priming effect.

In this context, given the ambivalent nature of metaphorical vehicles, the NCE would satisfactorily explain why no facilitation effect is found for congruent metaphorical targets. When participants are asked to judge the truth value of the sentence, they are invited to reflect on the metaphorical expression and, thus, its literal value may be due to pre-activation. This preactivation could be the reason for the negative priming effect when reading the metaphorical target. Accordingly, the NCE works as a positive priming in the incongruent metaphorically primed trial, since it pre-activates the literal meaning of the *vehicle*, which is referred to in the literal target.

Finally, the self-paced reading task is an online method to observe sentence processing and it is a more detailed and closer way to look at our data, since it allows us to know

the time participants used to process the critical word of each sentence. It also gave us some insight on the way participants processed metaphorically primed stimuli, which took longer to process than literally primed targets. Also, if we consider a NCE in these results, this task results does not nullify the class inclusion theory. However, it was probably not the best task to replicate the results in Gernsbacher et al. (2001). Since our study counts with the follow-up questions reaction times, they will be analyzed in session 4.5, in an attempt to check whether those results were replicated through the offline component of our task.

4.3 The Experiment: Baselines

In order to compare reaction time means for critical words in the self-reading task, our study counted with baseline pairs of unrelated sentences. Figure 9 shows the means for logical and nonsensical targets in the baseline condition.

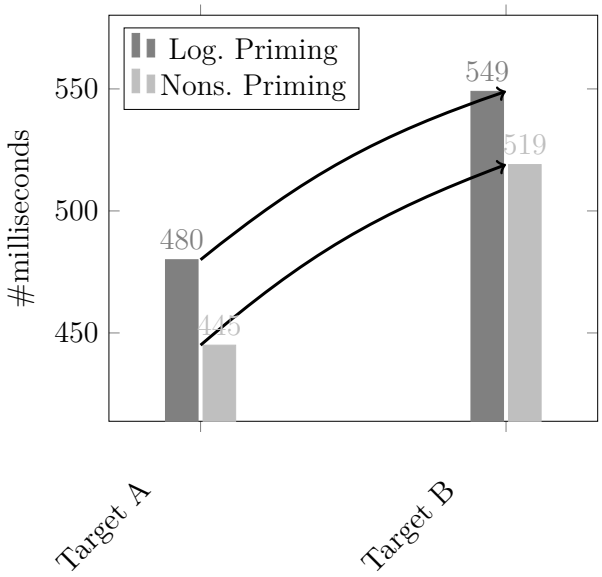

Figure 9: Baseline reading times for targets: logical and nonsensical pairs

Regarding the reading times for baselines, the difference in reading logical and nonsensical sentences is significantly longer in B than in A for both the literally primed (group A: M = 480 ms, group B: 549 ms, p. = 0.037) and the nonsensically primed target (group A: M = 445 ms, group B: 529 ms, p. = 0.002). These results show that even between unrelated sentence reading, inhibitory control plays a role. This may be due to the contribution of IC to cognition in general, or there might be underlying processes in

the task, of which we are not aware.

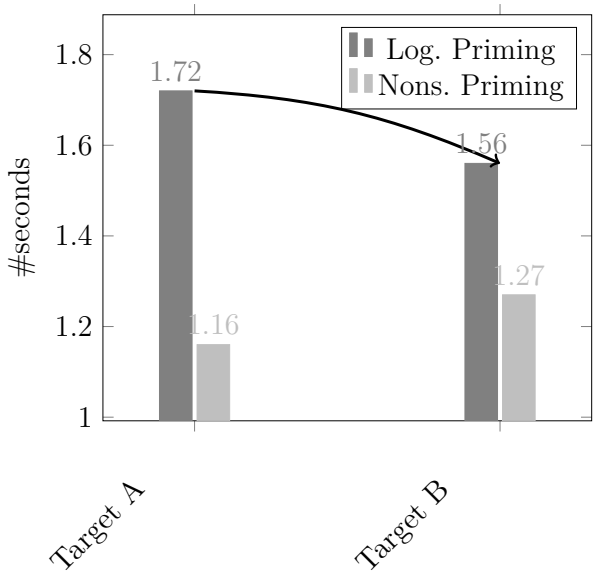

Figure 10: Baseline reaction times for follow-up questions: logical and nonsensical targets

In session 4.5, we will present the response times for the offline component of our task. In order to analyze those results, the RT's to the follow-up questions of baselines will be necessary and are, therefore, presented in figure 10.

When answering the follow-up questions, group A showed a slower reaction time (M = 1.72 secs, SE = 0.111) when compared to group B (M = 1.56 secs, SE = 0.106), p. 0.01 when priming sentences were logical. When primings were nonsensical, however, the groups did not show statistically significant differences.

4.3.1 Discussion

When observing the self-paced reading task, baseline reading times were longer for targets that followed logical primings than for targets following nonsensical ones. Group A reading times were faster than group B, even though targets were unrelated to priming sentences. This result might be a suggestion that, once there is a meaningful context, there will be an attempt to process the subsequent information based on it, which will demand cognitive effort and inhibition. Since cognitive processes take time, this would explain why logical primes make higher demand on cognition. Since nonsensical primes do not establish a proper context, there is little need for attempting to link pieces of information to one another.

However, these results were different when observing the offline measure obtained from the follow-up questions. Group A showed to be unexpectedly slower than group B when reading targets that followed an unrelated logical priming sentence. This would roughly mean that IC impacted results differently in a context where participants are expected to suppress the the priming. The underlying reasons for this result would be hard to pinpoint with an offline task such as ours.

4.4 The Experiment: Self-Paced Reading - Primings

In order to add one more reference to our analysis, we checked the reaction times for the literal, nominal metaphorical, conceptual metaphorical and nonsensical sentences that constituted the prime sentences. Since the priming sentences per se followed an unrelated sentence, it is possible to observe how fast those kinds of stimuli were read before the target was presented.

Just as for the experimental sentences and the baselines, reading times were computed only for the fifth word of each priming stimulus, which is the critical item of the sentence. For nominal metaphors, this word consists of the *vehicle*, and for conceptual metaphors, of a verb that conveys the metaphorical mapping.

4.4.1 Self-paced Reading - Primings: Nominal Metaphors

Statistical significance was found between groups A and B for the literal priming sentences, for which group A (M = 448 ms, SE = 0.029) showed faster reading times than group B (M = 577 ms, SE = 0.058), p. = 0.036. Figure 11 below shows the reaction times for groups A and B when reading the nominal prime sentences.

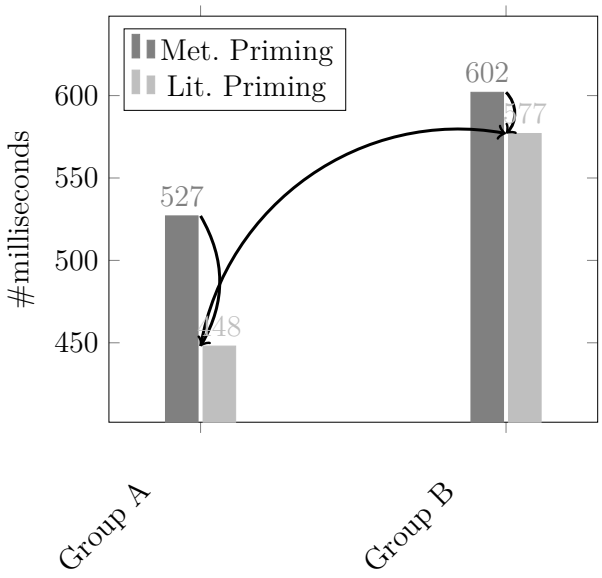

Figure 11: Reading times for nominal prime sentences

Within group A, reading literal primings showed to happen faster (M = 448 ms, SE = 0.029) than reading metaphors (M = 527 ms, SE = 0.029), p. = 0.0003. Within group B, too, reading literal primings was faster (M = 577 ms, SE = 0.058) than reading metaphors (M = 602 ms, SE = 0.056), p. = 2.6e-5.

These figures show evidence that reading metaphors takes more time than reading literal statements. That is, interpreting a metaphor would be more cognitively demanding than interpreting a literal sentence.

4.4.2 Self-paced Reading - Primings: Nonsensical Nominal Metaphors

As for nonsensical nominal metaphorical condition, figure 12 below shows the reaction times for groups A and B, when reading the metaphorical and literal sentences.

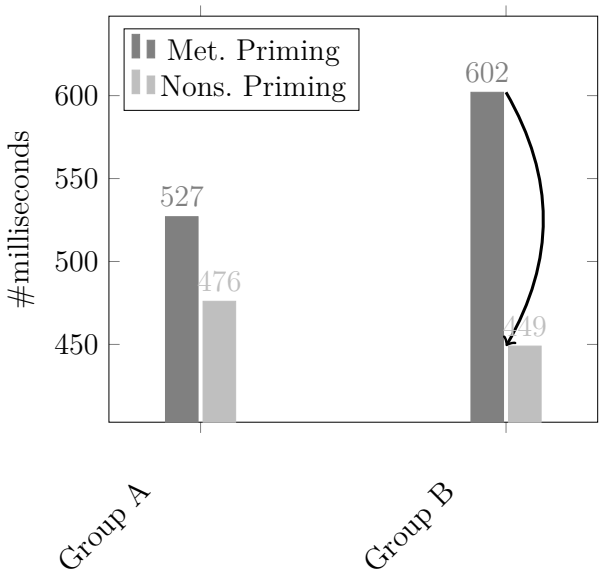

Figure 12: Reading times for nonsensical nominal prime sentences

There was no statistical significance between both groups for any of the four conditions. Also, within group A, no differences between the trials were found. On the other hand, within group B, reading nonsensical primings showed to happen faster (M = 449 ms, SE = 0.038) than reading metaphors (M = 601 ms, SE = 0.049), p. = 0.00027.

The lack of a significant difference within group A may indicate that participants of that group processed metaphorical and nonsensical sentences in the same fashion. That would be understandable, since the experimental nonsensical sentences are intrinsically metaphorical and, given the right context, could make perfect sense.

4.4.3 Self-paced Reading - Primings: Conceptual Metaphors

Regarding conceptual metaphors, there was statistical significance between groups A and B for the literal priming sentences. Overall, group A (M = 547 ms, SE = 0.052) showed faster responses than group B (M = 726 ms, SE = 0.053), p. = 0.042.

Figure 13 below illustrates the reaction times for groups A and B when reading the metaphorical and priming sentences.

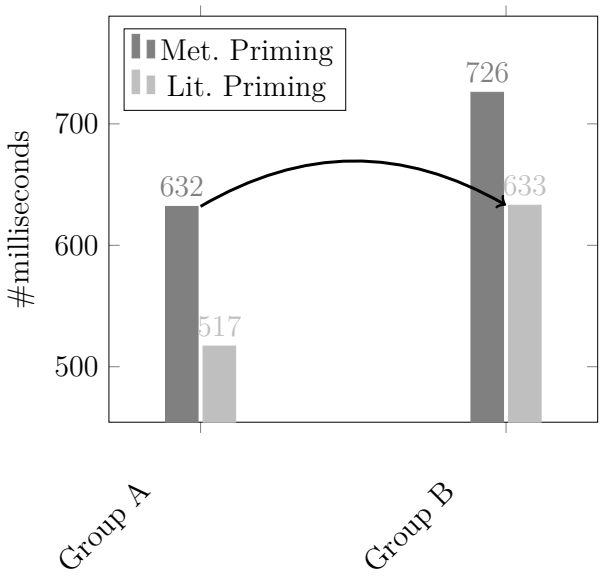

Figure 13: Reading times for conceptual prime sentences

Within groups there was, however, no statistical significance when reading the metaphorical nor the literal primings. The lack of statistical significance may be an indication of conceptual metaphors integration to language to such an extent that they do not need to go over processes such as comparison or categorization to be understood.

4.4.4 Self-paced Reading - Primings: Nonsensical Conceptual Metaphors

Difference was also found between groups for the nonsensical priming sentences, for which group A (M = 444 ms, SE = 0.028) showed faster responses than group B (M = 530 ms, SE = 0.042), p. = 0.05. Figure 14 below shows the reading times for groups A and B when primings were metaphorical and nonsensical.

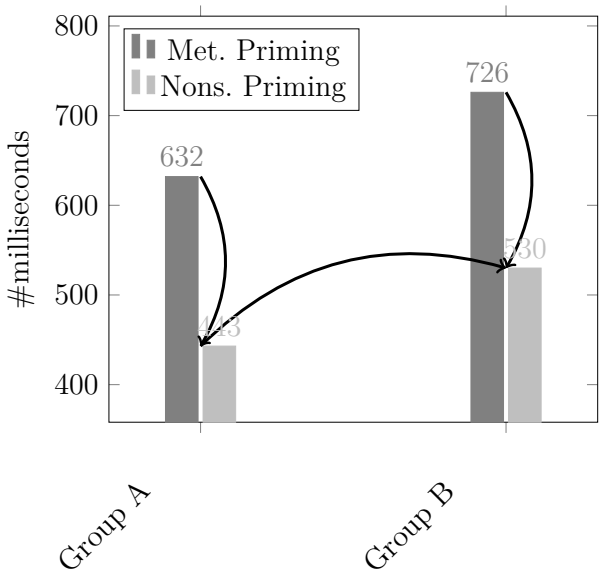

Figure 14: Reading times for nonsensical conceptual prime sentences

Within group A, reading nonsensical primings showed to happen faster (M = 444 ms, SE = 0.029) than reading metaphors (M = 632 ms, SE = 0.05), p. = 2.6e-5. Within group B, too, reading nonsensical prime sentences was faster (M = 530 ms, SE = 0.063) than reading metaphors (M = 726 ms, SE = 0.042), p. = 0.019.

These results show that the statistical analysis for these conditions are similar to those of the logical conventional metaphors, with both groups presenting statistically significant difference between metaphor and literal processing.

4.4.5 Discussion

Higher IC participants were faster to read literal primings in comparison to lower IC participants, and both groups were slower when reading nominal metaphorical primings than when reading literal primings. This result corroborates our idea (see session 4.2.5), that the goal-oriented aspect of our task may have influenced participants to focus on critical words that might carry a metaphorical meaning, and, in consequence, it may have caused an NCE.

When reading nonsensical primings, there were no significant differences between groups. However, within group B, reading nominal metaphorical sentences took more time than nonsensical sentences. It might be the case that the lack of statistical significance in group A indicates a higher difficulty from group A participants in judging metaphorical sentences apart from (metaphorical) nonsensical sentences. This result would then support Kazmerski et al. (2003), who found that high IQ participants took longer to discard

metaphors. This study would allow us to hypothesize that higher IC participants – since EF's are a fundamental part of human cognition – would also have a hard time discarding metaphorical sentences that did not make sense.

As for conceptual metaphorical primings, higher IC participants were, again, faster to read literal primings in comparison to lower IC participants. Also, for both groups, nonsensical sentences were faster to read than metaphorical ones, and both groups were slower when reading metaphorical primings than when reading literal primings.

In general, metaphors were slower to read in comparison to both literal and nonsensical sentences, which contradicts studies such as (KAPLAN, 1992; GIBBS; NAYAK; CUTTING, 1989). According to these studies, figurative sentences would take no longer to be read than their literal counterparts. The reason for that, as argued by Gibbs, Nayak and Cutting (1989) when comparing their results to those that displayed different results, would be syntactic instead of semantic. However, our nominal metaphorical sentences follow a consistent structure, suggesting either that the differences between literal and figurative processing actually exist or that there is a different nature for the differences in our results.

When comparing nominal and conceptual sentences, the former take less time to be read than the latter. Considering the career of metaphor hypothesis, in which nominal metaphors are said to be simultaneously interpreted as comparisons and categorizations, one possible explanation would be syntactic instead of semantic. Nominal metaphors have a simple formula of linking two nouns through a copula, but conceptual metaphors can vary syntactically, which would possibly lead to a difference in processing. However, this is unlikely in our study, since the self-paced reading only gives us the reading time for the vehicle, which is the critical word in our sentences, and not the total amount of time used to read the whole sentence.

Therefore, since our data does not rely on an offline measurement, it would be improbable that the reason for these results is other than a computational one. Besides, we believe that the theory of class inclusion alone cannot account for the reading time differences between nominal and conceptual metaphors. A better fit to our results would be found in the career of metaphor hypothesis, according to which nominal metaphors would go through a process of categorization and comparison at the same time. Since conceptual metaphors are implicit through their licensed expressions, it would make sense that the categorization process would happen first, followed by an inferential comparative process of computation.

4.5 The Experiment: reaction times for Follow-Up Questions

Gernsbacher et al. (2001), analyzed the reaction times for the follow-up questions, in which participants pressed a key in order to say whether the sentence made sense to them or not. Since our study was firstly thought of as a replication of this study, it became necessary to show how similar their offline measures are to our results.

In order to allow a parallelism with the original research, these results were initially not divided into groups A and B - since Gernsbacher et al. (2001) did not control participants' executive control. We then later divided the two groups, which showed an overall reaction time (primings and targets) statistically significant difference between groups, with group A processing sentences faster than group B, in all four conditions (nominal metaphors, p. = 0.0014, nonsensical nominal metaphors, p. = 0.0009, conceptual metaphors, p. = 0.003, nonsensical conceptual metaphors, p. = 0.0002).

4.5.1 Reaction times for Follow-up Questions: Nominal Metaphors

For the logical condition, participants were faster to answer to the congruent metaphorical target question (M = 1.61 secs, SE = 0.042) than to the incongruent target one (M = 1.78 secs, SE = 0.079), p. = 0.005. Participants were also faster to answer to the congruent literal target (M = 0.92 secs, SE = 0.046) than to the incongruent one (M = 1.003 secs, SE = 0.063), p. = 0.07.

The incongruent metaphorically primed target was answered faster than its congruent counterpart (p. = 8e-12) and the congruent literally primed target was answered faster than the incongruent one (p. =1.7e-10). Figure 15 illustrate participants' overall response means in this condition.

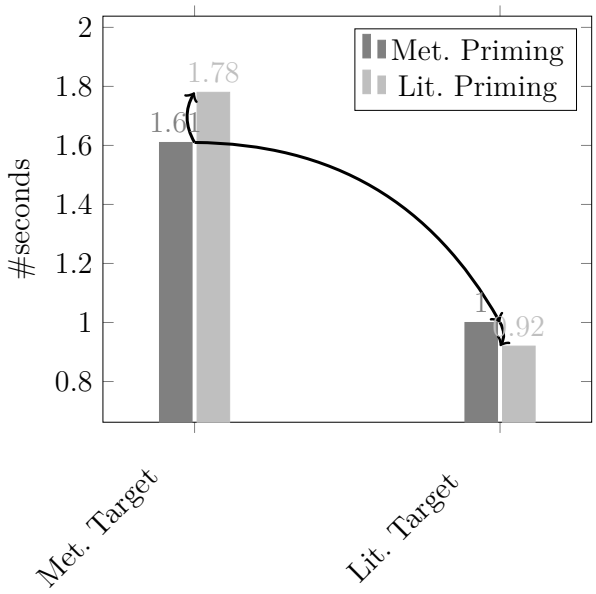

Figure 15: Response times for answering the follow-up questions in the nominal condition

When separating participants into groups A and B (higher and lower IC, respectively), the graphs overall look the same, as can be observed below.

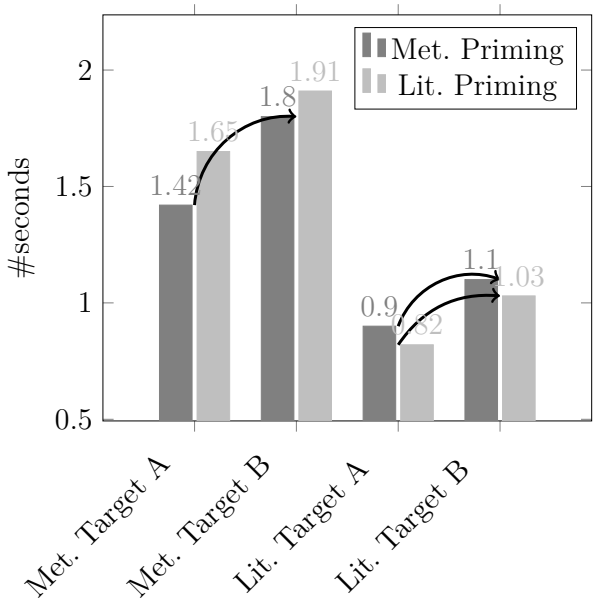

Figure 16: Groups' response times for answering the follow-up questions in the nominal condition

Group A participants were faster (M = 904 ms, SE = 0.055) than Group B participants (M = 1.102 secs, SE = 0.06) to process the question that followed an

incongruent literal target, p. = 0.02. Those participants were also faster (M = 1.42 secs, SE = 0.091) than the latter (M = 1.80 secs, SE = 0.123) to answer to the congruent metaphorical target, p. = 0.11. Also, when processing the congruent literal target, group B participants were slower (M = 1.03 secs, SE = 0.08) than those from group A (M = 815 ms, SE = 0.041), p. = 0.033.

These results are in accordance with the expectations we had for congruent and incongruent trials, in relation to the reaction times and, by extension, the demands on processing.

4.5.2 Reaction times for Follow-up Questions: Nonsensical Nominal Metaphors

As for the nonsensical nominal sentences, there was no significant difference between the reaction times of literally primed targets. Between the metaphorically primed, on the other hand, the congruent target was read slower (M = 1.61 secs, SE = 0.08) than the incongruent one (M = 1.003, SE = 0.042), p. = 8e-12. The congruent literal target, however, was read faster (M = 865 ms, SE = 0.054) than its incongruent counterpart, p. = 0.01. the opposite was also found for the metaphorical targets, where the incongruent target was read faster (M = 808 ms, SE = 0.039) than the congruent one (M = 1.61 secs, SE = 0.08), p. = 1.3e-11.

Figure 17 illustrate participants' overall response means in this condition.

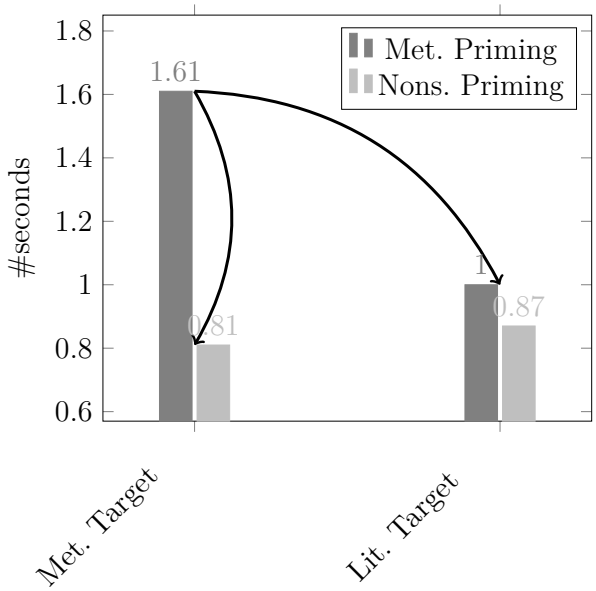

Figure 17: Response times for answering the follow-up questions in the nonsensical nominal condition

For the nonsensical condition, too, we separated participants into groups A and B,

as can be see in graph 18 below.

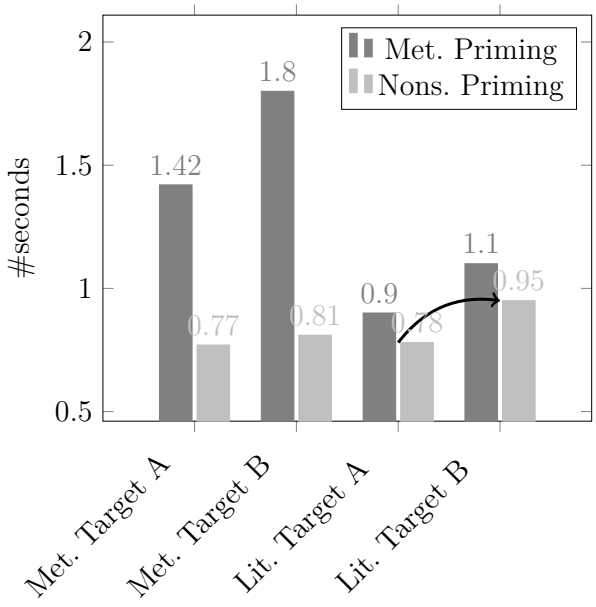

Figure 18: Groups' response times for answering the follow-up questions in the nonsensical nominal condition

Group A participants were faster (M = 782 ms, SE = 0.054) than Group B participants (M = 947 ms, SE = 0.06) to process the question that followed a congruent literal target, p. = 0.016. Those participants were also faster (M = 1.42 secs, SE = 0.091) than the latter (M = 1.80 secs, SE = 0.123) to answer to the congruent metaphorical target, p. = 0.12.

Differently from the ones in the nominal metaphor conditions, these results did not correspond to the expected outcome. First, there was no facilitation effect for the congruent metaphorical target. Second, There was no difficulty effect to the incongruent literal target. That is, the outcome to the metaphorically primed targets seems to be inconsistent.

4.5.3 Reaction times for Follow-up Questions: Conceptual Metaphors

In regards to the conceptual metaphor related pairs, the congruent metaphorically primed target was read slower (M = 1.067 secs, SE = 0.052) than the incongruent one (M = 2.86, SE = 0.10), p. = 1.9e-14. Similarly, the congruent literal target was read faster (M = 1.2 ms, SE = 0.085) than the incongruent one (M = 1.74 ms, SE = 0.087), p. = 9.2e-9. Also, the congruent literally primed target was read faster (M = 1.20 secs, SE = 0.085) than the incongruent one (M = 1.74 ms, SE = 0.087), p. = 4e-6. Similarly, the congruent

metaphorical target was read faster (M = 1.067 secs, SE = 0.052) than the incongruent one (M = 1.74 ms, SE = 0.087), p. = 8e-12.

Figure 19 illustrate participants' overall response means in this condition.

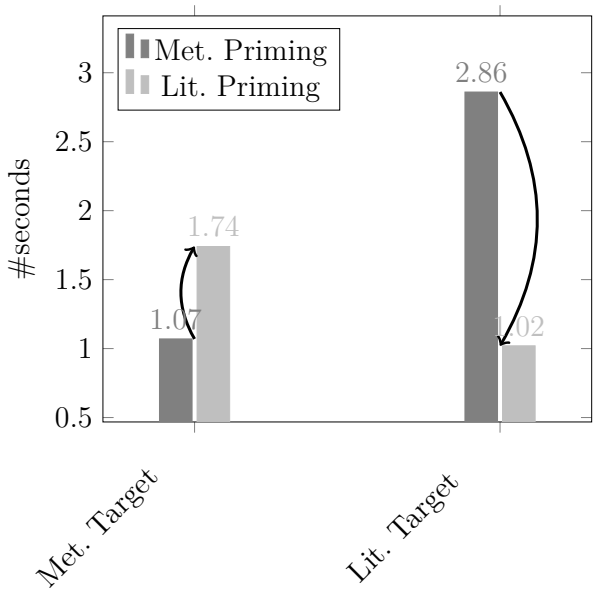

Figure 19: Response times for answering the follow-up questions in the conceptual condition

The graph 20 below shows the reaction times for groups A and B when the metaphorical primings were conceptual metaphors.

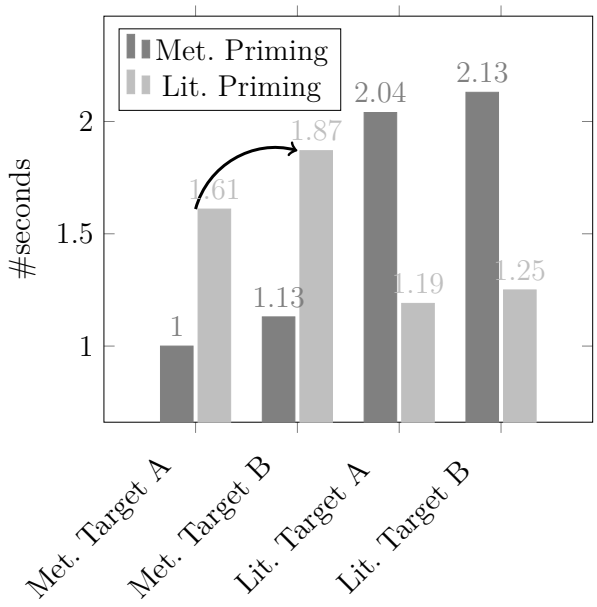

Figure 20: Groups' response times for answering the follow-up questions in the conceptual condition

Group A participants were faster (M = 1.61 secs, SE = 0.123) than Group B participants (M = 1.87 secs, SE = 0.119) to process the question that followed an incongruent metaphorical target, p. = 0.07.

Similarly to the nominal metaphor-related trials, these results reproduce the expected facilitation and difficulty effects depending on the experiment condition. Therefore, they also replicate the results in Gernsbacher et al. (2001).

4.5.4 Reaction times for Follow-up Questions: Nonsensical Conceptual Metaphors

As for the nonsensical conceptual pairs, there was no significant difference between the reaction times for the literal targets. Between the metaphorically primed targets, on the other hand, the congruent one was read slower (M = 1.07 secs, SE = 0.05) than the incongruent target (M = 953 ms, SE = 0.05), p. = 1.9e-14. Similarly, the congruent literally primed target was read slower (M = 1.38 secs, SE = 0.1) than the incongruent target (M = 954 ms, SE = 0.05), p. = 0.0002. For the literal target, there was a significant difference when the priming was metaphorical (M = 953 ms, SE = 0.05) from when the priming was literal (M = 1.38 secs, SE = 0.1), p. = 2.2e-6.

Figure 21 illustrate participants' overall response means in this condition.

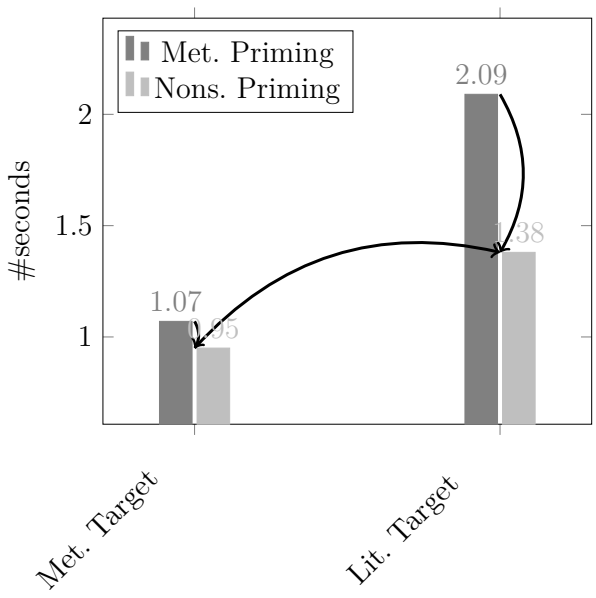

Figure 21: Response times for answering the follow-up questions in the nonsensical conceptual condition

Graph 22 below shows the reaction times for groups A and B when the metaphorical priming was a nonsensical conceptual metaphor.

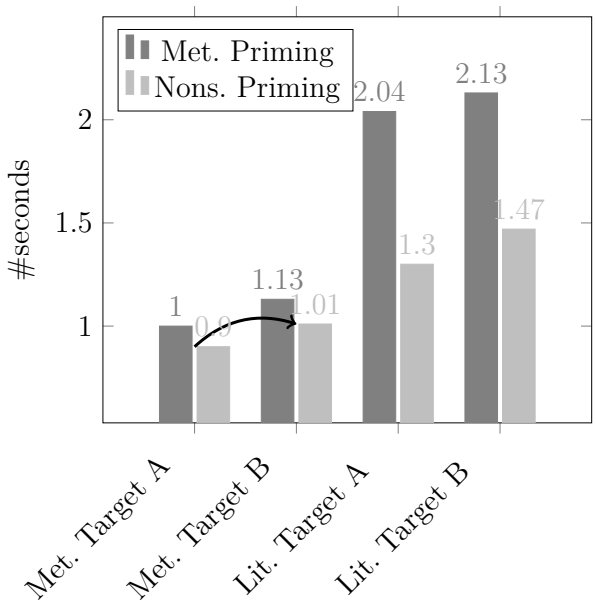

Figure 22: Groups' response times for answering the follow-up questions in the nonsensical conceptual condition

Group A participants were faster (M = 896 ms, SE = 0.077) than Group B

participants (M = 1.01 secs, SE = 0.063) to process the question that followed an incongruent metaphorical target, p. = 0.048. No other differences were found.

These results are similar to the ones in the nonsensical nominal metaphors and no differences were found within groups regarding either metaphorical targets or literal ones. Even though figure 4.17 could suggest that literal targets behave the way they are expected to (with a facilitation effect in congruent trials), there is no statistical prove on this matter.

4.5.5 Discussion

Overall, our results corroborate Gernsbacher and colleagues' (2001), when observing the reaction times to the follow-up questions. The combination of a priming with a target that has a related meaning yields a facilitation effect, while the combination of a priming with a target that has a non related meaning can make interpretation more difficult. The facilitation and the difficulty effects would be, therefore, a consequence of whether the priming information needs to be inhibited in order for the target computed or not.

In regards to the nominal metaphor related experimental pairs, the fact that we found statistical group differences between the congruent and incongruent literally primed targets, as well as the congruent and incongruent metaphorically primed targets might be used to support the 'metaphors as categorizations account' (GLUCKSBERG; KEYSAR, 1990). Class Inclusion Theory (GLUCKSBERG; KEYSAR, 1990) claims that metaphor interpretation happens through the creation of an ad hoc category, which would explain the facilitation and difficulty effects, through the use of suppression and enhancement, in reading metaphorically primed targets (GERNSBACHER et al., 2001). Our results showed that the IC plays a role in the processing of metaphorically primed incongruent targets, since participants with higher IC demonstrated a faster performance than those with lower IC.

As for the nonsensical nominal metaphor-related experimental pairs, however, our results do not resemble Gernsbacher et al.'s (2001), who found a similar pattern for both logical and nonsensical experiments. Our results show that, within both higher and lower IC groups, participants showed slower reading when the target was metaphorically primed. This may be due to the fact that - differently from literal and metaphorical primings, in which the reader must choose a suitable interpretation - the nonsensical priming pre-activates both meanings of a given vehicle (metaphorical and literal), none of which is selected at the end of the computation. This might yield an easier processing for both targets, which is supported by the comparison with the baselines, since a much faster reading time for incongruent nonsensically primed sentences was found. When separating participants in groups, it is possible to see that the group with higher IC performs faster in the metaphorically primed trial. The nonexistence of statistical significance between

both groups for nonsensically primed targets may suggest that there is a computational stage in which a sentence is neither metaphorical or literal. That is, a stage in which the figurative meaning might be accessed at the same time as the literal meaning, making the use of inhibition unnecessary.

Even though Gernsbacher et al. (2001) did not work with priming expressions licensed by conceptual metaphors, we found a similar pattern between reading times for targets, when compared to nominal metaphors. A facilitation effect was detected when the trial was congruent and a difficulty effect was detected when it was incongruent, which could also be used to support the class inclusion theory of metaphor. When separating participants into groups of higher and lower IC, we found difference between groups for incongruent metaphorical targets. This result can also be used to support it.

As for nonsensical conceptual metaphors, a pattern similar to that of nonsensical nominal metaphors was found, with metaphorically primed targets taking longer to process in both congruent and incongruent trials. Also, participants with higher IC were faster to answer to incongruent nonsensically primed targets. This would again reinforce the possibility of nonsensical input allowing the vehicle the status of both literal and metaphorical in meaning.

Interestingly, even though these offline measures did not capture the exact amount of time participants used for processing critical words in the online self-paced reading task, it allowed us to observe the outcome of the processing and was combinations were more demanding.

5 Final Remarks

5.1 General Discussion

The experimental design of the present study opened up the possibility to two different approaches to the collected data. Since the experiments combined the self-paced reading task with a judgment task, we were able to analyze both the offline and the online pieces of data in this thesis. Besides, the Stroop task was invaluable in our attempt to relate the career of metaphor hypothesis and the use of inhibitory control when processing metaphorical primings.

In short, this research aimed to investigate the role of inhibitory control in metaphorically primed sentences and the metaphorical sentences themselves. In order to do that, we statistically tested whether our participants could be divided into groups of higher and lower inhibitory control. After confirming the existence of both groups, we went on to analyze the performance of those participants in the self-paced reading, for which we statistically analyzed the reading times for the critical word. In metaphors, the critical word consisted of the vehicle, and in property statements, it consisted of the property word. Interestingly, the analysis of this online task did not show evidence for the categorization account, since there were no facilitation effects nor statistically significant differences between both groups.

When analyzing the reading times for primings, it was observed that participants were slower to read metaphors than to read literal stimuli. Besides, by default, priming stimuli always followed an unrelated sentence, and, hence, there was no previous related information to be inhibited. Therefore, the fact that inhibitory control was not found to be statistically relevant for the understanding of metaphors *per se* reinforces the categorization account in metaphor processing, as opposed to the comparison account, as well as the need to inhibit unnecessary information in order to process incongruent information related to it.

Interestingly, we found a negative priming effect in self-paced reading task, in which congruent metaphorically primed sentences took longer to be processed. We concluded that this effect, also called NCE (negative compatibility effect) was a consequence of the priming paradigm in combination with the follow-up question included in the task. As expected, this positive priming effect in the opposite direction was supported by the metaphorically primed sentence in the incongruent condition. We believe that the NCE could be used to support the categorization account of metaphors, since the difficulty to react to the metaphorical target means that the category was inhibited.

Finally, our study has been partially successful in replicating the study of Gernsbacher et al. (2001), having failed to replicate the same results for nonsensical metaphorical primings. However, our findings do support that metaphors are processed through categorization and that inhibition plays an important role in the process of inhibiting irrelevant information through the process. In nominal metaphor trials, higher IC participants performed faster than lower IC participants in metaphorically primed incongruent targets. In conceptual metaphors, higher IC participants have showed faster performance than lower IC participants when processing incongruent metaphorical targets. That it, besides replicating the authors' results, we were able to add information on the importance of IC in this process.

5.2 Limitations of the Present Study

The present study presents at least two main limitations. Firstly, our self-paced reading task was not able to capture the effects of metaphorical primings in the controlled targets. To solve this issue, one possible solution would be to supply our experiment with an eye-tracker device, in order to observe participants' fixation when reading the sentences. There is always the possibility of interference from the structure or other lexical entries. Secondly, because of time limitations, our study did not work on the participants' profiles in order to investigate the possible reasons for their higher and lower IC. It is our intent to look for these reasons in future analysis.

It would also be interesting if further research adapted our study in order to allow an online observation of the process. As for that, it would be necessary to hinder participants anticipation of the follow-up questions, or even the deletion of this kind of control. The reason for the inconsistent results in the self-paced reading task is not certain. It could either be that the task does not fit the design or that the selected stimuli generates item-related effects. In order to clear these questions, redesigning the experiment and making use of an eye-tracker device or a EEG could be more efficient.

5.3 Contributions of the Present Study

The search for understanding how humans process language has awoken the interest of many philosophers and scientists along the years, but is far from reaching an end. There are far too many theories and far too many studies, each of which either unfolds a piece of the big picture or offers a different point of view for unresolved matters, but much has yet to be discovered. Having this in mind, the present study has attempted to contribute to the field of language processing, more specifically to figurative processing and the use of executive functions in metaphorical processing.

First, we were able to successfully separate our participants in groups of higher and lower inhibitory control, which added some new information to whether IC plays a role in metaphor processing. Even though there seems to be no impact of IC in processing metaphoric expressions, our offline measures do show that higher inhibitory control participants process incongruent metaphorically primed targets faster than lower inhibitory control participants. This result supports the class inclusion theory, since metaphorical information is shown to be inhibited in those trials, in order for literal information to be processed.

Second, our self-paced task has shown that critical words, that can work as both the vehicle of a metaphor and in a literal way, are read slower when used as vehicles of a metaphor. This was also suggested by Brisard et al. (2001), who carried on two experiments with metaphors to test whether metaphors took indeed more time to read then literal expressions. In the case of our experiment, however, these findings could only be confirmed when metaphors were logical nominal metaphors. Additionally, we found that logical conceptual metaphors take longer to be read than their nonsensical counterparts. This counter-intuitive outcome of nonsensical sentences being interpreted faster than logical ones was also demonstrated in our baseline analysis, and is probably the reason for nonsensically primed targets to be read faster the the others.

Lastly, our self-paced reading experiment has also showed that targets seem to have a tendency to be interpreted as fast as their priming sentence. Since metaphors take longer to process, the same was true to their targets. In a similar fashion, because nonsensical primings take less time to process, so do their targets. Because this outcome is only true when we observe the online processing of these expressions, we were able to pinpoint its cause: the negative compatibility effect. Consequently, when we turn to the offline component of our task, which takes into account participants' RT's after processing happens, results look quite different. When participants took the time to reflect on the sentences and answer to a question about them, no negative priming effect was found. Interestingly, neither of these approaches nullify the career of metaphor. On the contrary, both online and offline aspects of the task complement each other and can be used to support the theory.

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Appendix

Stroop Task Stimuli

[25]

Word	Color	Word	Color
vermelho	red	escada	green
vermelho	green	teste	red
verde	green	controle	green
verde	blue	folha	green
azul	blue	abacaxi	blue
azul	red	sola	blue
vermelho	red	escova	red
vermelho	green	ficha	green
verde	green	porta	blue
verde	blue	gato	blue
azul	blue	periquito	red
azul	red	video	blue
carro	green	teste	red
caneta	blue	caderno	blue
cachorro	red	poste	blue
computador	green	ventilador	green
escada	green	cachorro	red
boneco	blue	caixa	green
estrela	blue	telefone	red

[25] The sequence of 36 words was repeated twice in random mode.

Self-paced Reading Stimuli

Sentences	Questions
O copo daquela calça estava vazio no domingo.	A sentença lida continha a palavra 'bolso'?
@ Papagaios fazem seus donos conversar todo dia.	Essa sentença fez sentido para você?
@ O aluno estava super quieto no início do ano.	Essa sentença fez sentido para você?
A porta queria dançar com o marido à noite.	A sentença lida continha a palavra 'mulher'?
A terra chamava sua irmã às pressas.	Essa sentença fez sentido para você?
* Cemitérios faziam seu sangue congelar à noite.	Essa sentença fez sentido para você?
* O lugar estava extremamente frio no inverno.	A sentença lida continha a palavra 'lugar'?
A dedicação fugiu veloz à marmita do pedreiro.	A sentença lida continha a palavra 'comida'?
Não havia nada dentro do navio cheio.	Essa sentença fez sentido para você?
@ Aquela caçamba estava totalmente vazia hoje.	Essa sentença fez sentido para você?
@ O pijama estava realmente limpo da lavagem.	A sentença lida continha a palavra 'pijama'?
A garrafa vestiu seu pijama antes de se deitar.	Essa sentença fez sentido para você?
As gavetas do carro estavam cheias de motores.	A sentença lida continha a palavra 'vidro'?
* O amor é um abacaxi azedo para muita gente.	Essa sentença fez sentido para você?
* O abacaxi é uma fruta tropical bastante saborosa.	Essa sentença fez sentido para você?
O jardim botânico caiu da árvore ao entardecer.	Essa sentença fez sentido para você?
A mãe e a criança foram postas rápido na jarra.	Essa sentença fez sentido para você?
Aquele rapaz era o favorito no time de futebol.	A sentença lida continha a palavra 'goleiro'?
@ Aquela cobra de jardim injetou veneno sem exitar.	Essa sentença fez sentido para você?
@ Os quadros eram bastante caros naquela galeria.	A sentença lida continha a palavra 'pintura'?
A enfermeira injetou soro no braço do lápis.	Essa sentença fez sentido para você?

* Aquele homem estava bem pra baixo naquele dia.	Essa sentença fez sentido para você?
* A paciente estava muito triste com a notícia.	Essa sentença fez sentido para você?
A senha do cartão de crédito ria da piada ouvida.	Essa sentença fez sentido para você?
@ Há inúmeas máquinas de costura no porão da loja.	Essa sentença fez sentido para você?
@ O grande depósito estava sujo aquela semana.	A sentença lida continha a palavra 'areia'?
Os empresários comeram purê de sapato no bar.	A sentença lida continha a palavra 'batata'?
O estudante encheu o cofre com grandes tubarões.	Essa sentença fez sentido para você?
* Aquele rapaz era um palito quando era criança.	Essa sentença fez sentido para você?
* Palitos são compridos pedaços finos de madeira.	A sentença lida continha a palavra 'dente'?
O carpete mofado cheirava à limpeza da lavagem.	Essa sentença fez sentido para você?
O almoço no restaurante era servido à meia noite.	A sentença lida continha a palavra 'meio dia'?
@ O cachorro é um amigo amado para muitas pessoas.	Essa sentença fez sentido para você?
@ A pirâmide é uma obra egípcia bastante bela.	Essa sentença fez sentido para você?
O amaciante de roupas bebeu um copo de vodka .	A sentença lida continha a palavra 'camisa'?
O belo quadro fora queimado ao cair no rio mar.	Essa sentença fez sentido para você?
* Aquele lutador de box atacou seu oponente.	Essa sentença fez sentido para você?
* As mortes foram bastante brutas naquela noite.	Essa sentença fez sentido para você?
O lindo pássaro caiu pra cima do galho longo.	Essa sentença fez sentido para você?
As toalhas foram colocadas na água para secar.	A sentença lida continha a palavra 'sol'?
@ Aquela anta era muito esperta quando era filhote.	Essa sentença fez sentido para você?
@ Celulares são ágeis objetos finos bem úteis.	A sentença lida continha a palavra 'telefones?

As janelas de vidro fizeram um chá gostoso hoje.	Essa sentença fez sentido para você?
Ele falou com o cliente por telefone em pessoa.	A sentença lida continha a palavra 'compradores'?
* Aquela lesma é um animal sem concha.	Essa sentença fez sentido para você?
* Lesmas tem o corpo mole naturalmente.	Essa sentença fez sentido para você?
A moldura quebrada ainda está inteira como nova.	A sentença lida continha a palavra 'cacos'?
As rodas do carro patinaram pelo oceano de vento.	Essa sentença fez sentido para você?
@ Aquele cão é um amigo sem comparação.	Essa sentença fez sentido para você?
@ Mergulhadores tem treinos na água sempre.	A sentença lida continha a palavra 'treinamentos'?
O escrivão ainda não lera o bilhete já digitado.	A sentença lida continha a palavra 'papel'?
A vítima morreu com o veneno da cobra inofensiva.	Essa sentença fez sentido para você?
* Há inúmeras veias no coração de um ser humano.	Essa sentença fez sentido para você?
* A bela menina estava triste naquele lugar.	A sentença lida continha a palavra 'muito'?
O campo de futebol feito não passado ano.	Essa sentença fez sentido para você?
A água seca jorrava do rio profundo sem parar.	A sentença lida continha a palavra 'lago'?
@ Escorpiões são exemplo de comida na Ásia.	Essa sentença fez sentido para você?
@ Dicionários são obras bem longas de palavras.	Essa sentença fez sentido para você?
Para a reunião atrasada chegou adiantada.	Essa sentença fez sentido para você?
A chave do armário apenas abria a casa.	A sentença lida continha a palavra 'tranca'?
* Purgantes são tipos de laxantes poderosos.	Essa sentença fez sentido para você?
* Purgantes são algo muito ruim ao paladar.	A sentença lida continha a palavra 'muito'?
O apartamento foi construído em nuvens fofas.	Essa sentença fez sentido para você?
Latia o gato tão alto que ninguém ouvia.	A sentença lida continha a palavra 'miava'?
@ Aquela janela estava bastante falida na sexta.	Essa sentença fez sentido para você?
@ O médico da clínica surfou o domingo todo.	Essa sentença fez sentido para você?
* Aquele tomate sempre lhe fervia o sangue à noite.	Essa sentença fez sentido para você?

* A temperatura era bem alta durante a madrugada.	Essa sentença fez sentido para você?
As páginas do diário foram lidas sem parar.	A sentença lida continha a palavra 'diário'?
As rochas cantaram muitas músicas no verão.	Essa sentença fez sentido para você?
Reis eram gente muito rica que liderava o povo.	Essa sentença fez sentido para você?
As curtas visitas do circo eram assunto geral.	A sentença lida continha a palavra 'circo'?
* Aquele espelho é um foguete muito lento.	Essa sentença fez sentido para você?
* Foguete é um veículo veloz que vai ao espaço.	Essa sentença fez sentido para você?
@ Aquele livro é uma girafa realmente longa.	Essa sentença fez sentido para você?
@ Ebulidores são um objeto útil que ferve água.	Essa sentença fez sentido para você?
Os rapazes tiveram uma partida justa.	A sentença lida continha a palavra 'jogo'?
As barras de doce se chocaram com os tiros.	A sentença lida continha a palavra 'morango'?
* Aquela insatisfação estava muito pesada na rua.	Essa sentença fez sentido para você?
* A situação era bem ruim entre os dois amigos.	Essa sentença fez sentido para você?
A bolsa de moedas resmungou com a ameaça.	A sentença lida continha a palavra 'moeda'?
@ A espera estava bem difícil mas foi fácil demais.	Essa sentença fez sentido para você?
@ A série é bem nova para um canal tão antigo	Essa sentença fez sentido para você?
A morte do teto irritou os clientes da galeria.	A sentença lida continha a palavra 'arte'?
* Aquela foto é um armário desde a semana passada.	Essa sentença fez sentido para você?
* Armários são belos móveis grandes de madeira.	Essa sentença fez sentido para você?
A dona da casa expulsou a formiga com um abraço.	A sentença lida continha a palavra 'açúcar'?
@ Aquele celular é uma pêra desde o feriado.	Essa sentença fez sentido para você?
@ Fazendas são imensos pedaços férteis de terra.	Essa sentença fez sentido para você?
O rapaz errou as respostas e ganhou o jogo.	A sentença lida continha a palavra 'acerto'?
* As estrelas estavam bem escuras no domingo.	Essa sentença fez sentido para você?

* A luz do poste caiu na rua toda ontem à tarde.	Essa sentença fez sentido para você?
O velho rádio tocava sons que animaram a festa.	A sentença lida continha a palavra 'velho'?
Aquele lápis nada no córrego todos os meses.	Essa sentença fez sentido para você?
Violetas são lindas flores roxas que florescem.	Essa sentença fez sentido para você?
Cadeiras quebradas são copos de plástico.	A sentença lida continha a palavra 'pedaços'?
* Aquele hidratante vive na floresta todos os dias.	Essa sentença fez sentido para você?
* Leões são belos felinos fortes que caçam.	Essa sentença fez sentido para você?
@ Aquele padre nunca lhe dizia toda manhã.	Essa sentença fez sentido para você?
@ O clima era muito quente durante o outono.	Essa sentença fez sentido para você?
O pote estava lacrado acima da estante de livros.	A sentença lida continha a palavra 'refratário'?
Máquinas de costura fazem boas cafeteiras.	A sentença lida continha a palavra 'cafeteiras'?
* A nuvem estava super pesada mas valeu à pena.	Essa sentença fez sentido para você?
* A situação é bastante árdua para muita gente.	Essa sentença fez sentido para você?
Árvores de natal são montadas no fim do ano.	A sentença lida continha a palavra 'fim'?
A caixa preta estava cheia de documentos.	A sentença lida continha a palavra 'caixa'?
@ Aquele prego estava bem tristonho no fogão.	Essa sentença fez sentido para você?
@ A miséria era bem comum em guerras mundiais.	Essa sentença fez sentido para você?
* As portas fizeram muitos milagres este ano.	Essa sentença fez sentido para você?
* Santos eram pessoas muito boas que curam.	Essa sentença fez sentido para você?[26]

[26] The sentences marked with * are the experimental pairs, the ones marked with @ are baseline pairs. Distractor sentences are not marked.

Informed Consent Form - Termo de Consentimento Livre e Esclarecido

Você está sendo convidado a participar de minha pesquisa de mestrado, desenvolvida sob a orientação do Prof. Dr. Ricardo Augusto de Souza. A pesquisa desenvolvida trata da compreensão da linguagem de falantes do português brasileiro. A realização desta pesquisa contribuirá para entendermos com mais clareza o modo como o falante do português realiza o processo de compreensão e os mecanismos cognitivos utilizados em tal processamento. Se você se interessar em participar, sua tarefa consistirá em ler algumas palavras e sentenças.

A sessão dura aproximadamente 20 minutos, a depender de sua velocidade individual, e é feita no Laboratório de Psicolinguística, no campus Pampulha (Faculdade de Letras, terceiro andar).

Não prevemos nenhum risco ou desconforto relacionado à coleta descrita aqui. Você não estará sendo avaliado nem julgado. Apenas nos interessa investigar habilidades que todos os falantes adultos da língua possuem.

Durante a coleta não serão perguntadas questões relacionadas à sua vida pessoal, nem serão tratados assuntos controversos ou delicados. A participação no estudo é voluntária e você tem a liberdade de se recusar a participar ou interromper a coleta de dados, ou ainda de retirar seu conhecimento a qualquer momento, sem que isso lhe cause qualquer prejuízo. Esclarecemos ainda que sua participação não implica nenhum gasto de sua parte ou pagamento da nossa.

Sua identidade será mantida em sigilo durante todo o processo de coleta, transcrição e análise de dados, de forma a garantir-lhe total privacidade. Os resultados desta pesquisa, o qual engloba os dados coletados em suas sessões, serão apresentados em congressos, artigos, e outros textos científicos do gênero, mas manterá em sigilo informações individuais dos participantes.

Coloco-me à disposição para prestar esclarecimentos sobre qualquer dúvida que você possa ter com relação à metodologia empregada neste estudo, tanto antes como depois de sua execução. Ao fim deste formulário, você encontrará minhas informações de contato.

Agradeço sua participação,

Nome do voluntário:

Sexo: Feminino ( ) Masculino ( )

Área de estudos (curso):

Belo Horizonte, de de 2018

Assinatura do participante

Online Questionnaire

Questions
Qual seu endereço de e-mail?
Você leu o termo e aceita colaborar voluntariamente da pesquisa à qual este formulário é destinado?
Esta pesquisa é coletada no Laboratório de Psicolinguística, na Faculdade de Letras. Você será contactado por email para agendamento de uma sessão. Caso prefira, este contato pode também ser feito por meio de whatsapp. Caso assim prefira, adicione seu telefone na opção 'outros'.
Qual a sua idade?
Dentre as atividades abaixo, marque aquelas que fazem parte de seu dia-a-dia: Resolução de problemas Contato com idiomas estrangeiros Faculdade Atividade física regular 6-8 horas de sono Trabalho artístico (música, desenho, design, etc.)
Você tem contato com línguas estrangeiras? Quais?
Qual você acredita ser sua proficiência nesse(s) idioma?
Você é destro ou canhoto?
Você já sofreu ou sofre de alguma problema neurológico? (depressão, AVC, amnésia, etc.)
Você tem problema de acuidade visual? Se sim, usa óculos para correção?
Qual seu nível de escolaridade?

ANNEX - SHAPIRO-WILK

In this chapter we present information that might be relevant to the understanding of this research.

Data Analysis: Shapiro-Wilk for experimental sentences and baselines[26]

	incong	*m11*	*b11*	*m12*	*b12*	*m13*	*b13*	*m14*
W-stat	0.916004	0.872492	0.731413	0.802882	0.803012	0.733912	0.870762	0.687026
p-value	0.000942	3.13E-05	1.07E-08	3.96E-07	3.99E-07	1.2E-08	2.77E-05	1.53E-09
alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
normal	no	no	no	no	no	no	no	no

b14	*m21*	*b21*	*m22*	*b22*	*m23*	*b23*	*m24*	*b24*
0.884121	0.701511	0.663675	0.832711	0.572532	0.848604	0.907216	0.82099	0.966209
7.29E-05	2.82E-09	5.89E-10	2.27E-06	2.09E-11	6.17E-06	0.000448	1.12E-06	0.124026
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
no	no	no	no	no	no	no	no	yes

m31	*b31*	*m32*	*b32*	*m33*	*b33*	*m34*	*b34*	*m41*
0.832962	0.79899	0.587825	0.813335	0.799926	0.914925	0.945165	0.920986	0.92235
2.3E-06	3.19E-07	3.53E-11	7.16E-07	3.36E-07	0.000858	0.014141	0.001456	0.001644

[26] b-sentences describe baselines, while m-sentences describe critical sentences. Odd-numbered sentences are primings and even-numbered, targets.

0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
no	no	no	no	no	no	no	no	no

b41	*m42*	*b42*	*m43*	*b43*	*m44*	*b44*	*mc11*	*bc11*
0.512012	0.862039	0.844631	0.959646	0.915141	0.850695	0.857511	0.814568	0.776958
2.96E-12	1.51E-05	4.78E-06	0.0623	0.000875	7.08E-06	1.11E-05	7.69E-07	9.84E-08
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
no	no	no	yes	no	no	no	no	no

mc12	*bc12*	*mc13*	*bc13*	*mc14*	*bc14*	*mc21*	*bc21*	*mc22*
0.878018	0.921695	0.913323	0.900965	0.795919	0.739699	0.776193	0.820353	0.841741
4.65E-05	0.001551	0.000748	0.000269	2.7E-07	1.57E-08	9.46E-08	1.08E-06	3.98E-06
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
no	no	no	no	no	no	no	no	no

bc22	*mc23*	*bc23*	*mc24*	*bc24*	*mc31*	*bc31*	*mc32*	*bc32*
0.767198	0.895289	0.675559	0.852733	0.676318	0.826531	0.766736	0.945134	0.676615
5.98E-08	0.000171	9.51E-10	8.09E-06	9.81E-10	1.56E-06	5.84E-08	0.014097	9.93E-10
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
no	no	no	no	no	no	no	no	no

mc33	*bc33*	*mc34*	*bc34*	*mc41*	*bc41*	*mc42*	*bc42*	*mc43*

0.964849	0.877085	0.924012	0.855279	0.504206	0.821633	0.546876	0.41754	0.630972
0.10754	4.35E-05	0.001908	9.57E-06	2.33E-12	1.16E-06	8.94E-12	1.92E-13	1.67E-10
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
yes	no	no	no	no	no	no	no	no

bc43	*mc44*	*bc44*
0.784332	0.742462	0.523233
1.45E-07	1.79E-08	4.2E-12
0.05	0.05	0.05
no	no	no