Attention to Metaphor

From neurons to representations

Valentina Cuccio

Metaphor in Language, Cognition & Communication 7

John Benjamins Publishing Company

Attention to Metaphor

Metaphor in Language, Cognition, and Communication (MiLCC)

ISSN 2210-4836

The aim of the series is to publish theoretical and empirical interdisciplinary research on the effective use of metaphor in language and other modalities (including, for instance, visuals) for general or specific cognitive and communicative purposes. The aim of the series is to offer both fundamental and applied contributions to the state of the art. The series also invites proposals for inter-cultural and cross-cultural studies of metaphor in language, cognition, and communication. Room will be given as well to publications on related phenomena, such as analogy, metonymy, irony, and humor, as long as they are approached from a comparable perspective. The scope of the series comprises approaches from the humanities and the social and cognitive sciences, including philosophy, cultural studies, linguistics, cognitive science, communication science, media studies, and discourse analysis. More focused attention may be paid to the role of metaphor in the domains of religion, literature and the arts, the media, politics, organization and management, law, economics, health, education, and science.

For an overview of all books published in this series, please see
http://benjamins.com/catalog/milcc

Volume 7

Attention to Metaphor: From neurons to representations
by Valentina Cuccio

Attention to Metaphor

From neurons to representations

Valentina Cuccio
University of Parma

with a contribution by

Gerard Steen
University of Amsterdam

John Benjamins Publishing Company
Amsterdam / Philadelphia

The paper used in this publication meets the minimum requirements of the American National Standard for Information Sciences – Permanence of Paper for Printed Library Materials, ANSI Z39.48-1984.

In collaboration with the Metaphor Lab Amsterdam.

DOI 10.1075/milcc.7

Cataloging-in-Publication Data available from Library of Congress.

ISBN 978 90 272 0211 6 (HB)
ISBN 978 90 272 6335 3 (E-BOOK)

John Benjamins Publishing Company · https://benjamins.com

Table of contents

Introduction

When we sit in our armchair reading a novel and are transported into the story, we often feel as if we ourselves were living through the experiences undergone by the characters of the novel. We feel as if we were experiencing the same situations and having the same sensations, desires, pleasure and pain narrated in the story. The experiences of the characters of the novel resonate in us. This is the magic of literature: we can have hundreds of different experiences just sitting in our living room. Analogously, when we go to the cinema or to the theatre, we can be absorbed by what we see to the extent that we feel it in our own bodies.

The phenomenon described above is certainly not new for scholars working in the Humanities, or indeed for anyone who just enjoys reading books or frequenting cinemas and theatres. Today's neurosciences seem to have identified the biological mechanism that lies at the basis of this experience of bodily and emotional resonance. This was made possible by the discovery of mirror neurons (di Pellegrino et al., 1992). Mirror neurons are neurons in the premotor cortex that are activated by both the real execution and the observation of actions. The activation of these neurons causes a simulation of the observed actions in our own motor system (Embodied Simulation). The mechanism of simulation is recruited by many different cognitive tasks such as, for example, mental imagery and, indeed, language comprehension. When we read a novel and we feel that the experiences lived through by the characters of the story resonate in us, our motor system, as well as other parts of the brain related to perception and emotion processing, is activated as if we were really living through those experiences ourselves (Willems, 2017).

The discovery of mirror neurons in the last decades of the twentieth century has had a tremendous impact on many different fields and across many different disciplines and given enormous momentum to the research programme of Embodied Cognition. Ranging from social cognition to language comprehension, from the enjoyment of works of art to the explanation of tool-use behaviour, from mental imagery to conceptual processing, from empathy to our comprehension and enjoyment of poetry, literature and movies, these and many other issues are now being addressed with reference to mirror neurons and to the mechanism of simulation.

Neuroscientific discoveries in the area of mirror neurons and the mechanism of Embodied Simulation have also had a tremendous impact on the field of metaphor studies. They have even diverted a lot of research towards exploring the possibility of a neural foundation for the Conceptual Metaphor Theory. The aim of this book is to account for the bodily foundation of conceptual metaphors in the light of these neuroscientific discoveries and also to consider a revision of the contemporary theory of metaphor recently introduced, and already having an increasing impact on the field, by Steen (e.g., 2008, 2011), who distinguished between deliberate and non-deliberate metaphor processing. A new model of metaphor processing will be proposed here. This model will bring together the mechanism of Embodied Simulation on the one hand and the notion of deliberateness on the other. Modulation of attention during linguistic processing will be a key component in explaining how they interact.

To achieve the aim of this book and develop this new model of metaphor processing, we must first acknowledge that the debate on the cognitive role of the mechanism of simulation is currently wide open (e.g., Gallese and Cuccio, 2016, 2018) and, more generally, that many controversial questions lie at the very heart of theories of Embodied Cognition. As a consequence, these issues also lie at the heart of any embodied approach to conceptual metaphors: the contribution of the body to conceptual metaphor processing is not clearly delineated in the literature. The nature of that contribution therefore needs to be better defined before any attempt can be made to develop a bodily grounded model for metaphor processing.

The major critical issues are related to the very definition of the notion of embodiment. Embodied Cognition has certainly not elicited a unitary research programme. Many different accounts have been provided so far for the role of the body in human cognition and hence many different meanings and conceptions of "embodiment" have been proposed (cf. Shapiro, 2011, 2014). Since the topics, approaches, methodologies and lines of research classified under this umbrella term are all quite disparate, it is not my aim here to provide an overview of the current debate. It will be sufficient to refer to the work of Shapiro (2011), who reviews this debate and identifies at least three conceptions of "embodiment" that, in his view, can be traced back to the work of Varela, Thompson and Rosch (1991), Thelen (Thelen, Schöner, Scheier, and Smith, 2001), and Clark (2008), respectively. In Shapiro's words, these different conceptions of embodiment are referred to as the Conceptualization, the Replacement, and the Constitution hypotheses.

The main defining feature of the Conceptualization hypothesis is, according to Shapiro (2011), the claim that our understanding and conceptualization of the world are a function of our body and of the sensory apparatuses we are equipped with. The side effect of this claim, in Shapiro's view, is that we may lose the idea that there really is an objective world to know.

> […] Varela, Thompson, and Rosch's focus on world building is an example of research that fits into a broader effort that I shall call the hypothesis of *Conceptualization*. Work falling under the Conceptualization heading seeks to show that an organism's understanding of the world – the concepts it uses to partition the world into understandable chunks – is determined in some sense by the properties of its body and sensory organs. Whether the truth of Conceptualization requires that one abandon the idea of an objective world, as Varela, et al. seem to suggest, is an issue we will have to consider. (Shapiro 2011, 68)

Many influential scholars are currently operating under the rubric of the Conceptualization hypothesis. Alva Noë (2004) is one example and, according to Shapiro (2011, 86), even researchers working in the paradigm of Conceptual Metaphor Theory can be considered defenders of the Conceptualization hypothesis.

As for the Replacement hypothesis, its positions are endorsed by the most radical embodied theorists, who, contrary to the theses proposed by the Computational and Representational Theory of Mind, aim to offer explanations of human cognition that do not resort to the notion of mental representation. Shapiro (2011) traces the project of the Replacement hypothesis back to two different lines of research. One is dynamical systems theory (e.g., Kelso, 1995; Port and van Gelder, 1995). The other is related to robotics (e.g., Brooks, 1991). This hypothesis can be regarded as offering the most assertive opposition to computationalism. Whether the project of explaining the human mind without any resort to mental representations can be pursued to its ultimate consequences is certainly a problematic issue.

> […] Thelen provides an example of research that might more broadly be seen as supporting the hypothesis of *Replacement*. Those engaged in Replacement projects are convinced that the computational and representational tools that have for so long dominated standard cognitive science are in fact irremediably defective, and so must be abandoned in favor of new tools and approaches. These approaches, it is claimed, capture the important elements of cognition, but do so without recourse to a vocabulary pregnant with computational concepts. Dynamical systems theory is one such approach, as is the roboticist Rodney Brooks's subsumption architecture. But whether these strategies can truly account for all of cognition, and whether they really are free of any representational residue, are topics that will require careful attention. (Shapiro 2011, 68)

Finally, the central claim of the Constitution hypothesis is related to the constitutive role that the body has in our cognitive processes. Contrary to computational approaches to the study of the mind, scholars working in research projects developed under the label of the Constitution hypothesis believe that the body, and not only the brain, has a constitutive role to play in our cognition and is part of the mind. Interestingly, for some scholars in this research line, the claim of the embodiment of the mind in the physical body does not even go far enough. The mind, in this view, extends beyond the body and also incorporates part of the world.

> Finally, Clark's fairly encompassing view of embodied cognition is engaged in a *Constitution* project. The distinguishing feature of projects in support of the hypothesis of Constitution is a commitment to the idea that the constituents of the mind might comprise objects and properties apart from those found in the head. Those who endorse Constitution believe that in an important sense, but one which we must take pains to clarify, mental activity includes the brain, the body, and the world, or interactions among these things. (Shapiro 2011, 68)

This brief overview allows us to see that the critical differences among these conceptions of embodiment are concerned with the hotly debated issues of what counts as the body and what role the notion of representation can play in explaining human cognition. These controversial issues lie at the centre of the current debate on all embodied approaches to cognition. Scholars working in each of these three different approaches to embodied cognition clearly take different stances on these issues. These differences can be easily detected on the basis of Shapiro's passages quoted above. Each of the different approaches to embodiment has interesting solutions to offer to understanding the human mind in all its complexity. But, at the same time, each of them inevitably faces problems and theoretical difficulties.

I will not discuss the Conceptualization, Replacement and Constitution hypotheses in further detail here: it is not my purpose to scrutinize and compare these options more deeply, although it is very important to have clearly present in one's mind the variety of different hypotheses that are currently available in the field of Embodied Cognition (at least three, according to Shapiro, 2011; or, for example, even six according to Wilson, 2002). I will instead take all this as a background against which I will focus on a more circumscribed issue: the theoretical definition of the mechanism of Embodied Simulation. What the cognitive role of this mechanism is and how we should define it seem to be questions that are not entirely clear and need to be addressed. At the same time, in dealing with the theoretical definition of Embodied Simulation I will also have occasion to touch on both of the central and critical issues of the embodiment debate, that is, the definition of the notion of body, and the relevance of certain representational explanations of human cognition.

In the main, Embodied Simulation has been defined by going back to the notion of representation: the activation of the mechanism of Embodied Simulation has been considered to be the occurrence of a representation in a specifically bodily format. To give some examples, the activation of motor neurons when we observe someone else performing a motor action (e.g., kicking a ball) has been regarded as the occurrence of a representation of that action in a *motoric* format; in the same vein, the activation of visual neurons when we imagine we see a landscape has been considered to be the occurrence of a representation in a *visual* format, and so on. However, in the current discussion of the nature of the mechanism of simulation, this representational account has not been unanimously accepted. On this point, then, some clarifications are necessary.

In the debate we may identify two different attitudes to the mechanism of Embodied Simulation. On the one hand, some scholars (for example, Gallagher, 2015) seem to reject the very concept of simulation. In his view, the activation of mirror or canonical neurons[1] when we are not actively engaged in actions, perceptions or emotional experiences does not satisfy the minimal requirements for recognition as a simulation. Researchers who, like Gallagher, do not buy into a simulationist account of this mechanism, usually adopt explanations that do not imply any notion of representation. By contrast, those who do buy into a simulationist explanation of findings related to mirror and canonical neurons unanimously adopt a representational explanation of this mechanism. Hence, the decision to define the activities of mirror and canonical neurons as simulation usually presupposes a correlated, and more or less explicit, choice in favour of a representational characterization of this mechanism. In these accounts, the activation of the mechanism of simulation is regarded as the occurrence, at the neural level, of a modality-specific representation which, as we have seen in the preceding lines, is encoded in a *bodily format*. Summarizing the differences between these two tendencies, we may say that those who do not define the mirror mechanism in terms of simulation do not consider it to be a representation. In contrast, those who define this mechanism in terms of simulation do use the notion of representation to account for its role in human cognition.

For the sake of clarity and completeness, I must admit that representational explanations of the mechanism of simulation are quite popular and it is not difficult to see why this is the case. Positions involving the adoption of a representational account of Embodied Simulation may be theoretically highly convenient because they offer an easy explanation for the cognitive role of this mechanism. In this view, the motor system as well as other brain structures can immediately provide representations, albeit in specific formats related to the body, over which it is then possible to apply computations (Barsalou 1999, 2008). If Embodied Simulation is considered to be a representation, we do not need much more than the rudiments

1. Canonical neurons are neurons in the motor system that respond both to the performance of grasping actions and to the observation of prehensile objects (see Rizzolatti and Sinigaglia, 2006)

of the Computational and Representational Theory of Mind's account to explain its role in our cognitive processes. From this point of view, representational accounts of the mechanism of simulation are not so distant from standard cognitive science theories of human cognition.

Yet, as we will see in the first chapter of this volume, representational accounts of Embodied Simulation are problematic for many reasons. It is theoretically not plausible to ascribe representational content and genuine intentionality to neurons (see Hutto and Myin, 2013 for a discussion). A naturalistically plausible account of content is not yet available. As a consequence, a representational account of Embodied Simulation does not stand the test of manifesting genuine representational properties.

But if Embodied Simulation is not a representation, what is, then, its role in human cognition? How can this mechanism contribute to language understanding, to social cognition and to all of the other cognitive tasks for which simulations are recruited? To answer these questions an alternative explanation of this mechanism has to be provided (Cuccio 2015a, 2015b). To this end, I will propose a simulationist account of this mechanism without resorting to the notion of mental representation in bodily format. More precisely, I will defend the claim that Embodied Simulation, if considered in a narrow sense, i.e., if merely considered to be the activation of mirror or canonical neurons when we are not actively engaged in actions, perceptions or emotional experiences, cannot be regarded as a mental representation. As we shall see, a representational, contentful account of Embodied Simulation only comes into play if we adopt a broader conception of this mechanism, where Embodied Simulation attunes us to our social world and provides us with a brain-related and a body-related disposition.

To make this point clear, let us think for a moment about what we feel when we see someone else facing a situation of acute physical pain: we often feel a sensation of discomfort in our own body. In this case, the mechanism of Embodied Simulation does not only trigger a pattern of neural activation in the pain-relevant brain regions (Ahmad and Abdul Aziz, 2014) that could be computationally manipulated as a representation. More importantly, it leads to an experience of bodily sensations. Embodied Simulation, in this view, sets off a brain state and a bodily state. The latter, in particular circumstances, leads to the experience of bodily sensations The bodily states and sensations aroused by the mechanism of simulation contribute to many cognitive processes, including action understanding, social cognition and language comprehension.

By the end of this book, it will have been shown that this new and more comprehensive account of the mechanism of simulation, in interaction with the notion of attention, is a key element to providing a deeper understanding of the role of the body in conceptual metaphors. On this basis, a new model of metaphor processing will be developed that takes the distinction between deliberate and non-deliberate metaphors into consideration.

Thus, the proposals advanced in the first chapter of this volume about the definition of the mechanism of Embodied Simulation will be applied to the issues that are currently being discussed in the field of metaphor studies. Indeed, in the light of these proposals, in the second chapter of this book, I will review some of the main positions in the Conceptual Metaphor Theory debate and see how the discovery of the mechanism of simulation has been received in this debate. As will be clear from this brief analysis, my proposal offers an innovative and original approach to the development of the topic of the embodiment of conceptual metaphors that may form the basis for a new interpretation of existing data.

The need to deal with objections to representational accounts of Embodied Simulation in the narrow sense and to present an alternative explanation for this mechanism inevitably leads us to the definition of "body" – which I will address in Chapter 3. Although this may seem a trivial problem, there are no clear and unambiguous definitions in the debate of what scholars mean by the term "body" when they talk of embodiment. For example, for some scholars the body is mainly the brain; for others the notion of body refers to the rest of the body and not merely to the brain. And for some other researchers the body, in embodied accounts of cognition, is predominantly the object of our conceptual and linguistic representations that may give structure to abstract concepts not related to physical experiences.

In what follows I will show that the notion of body can be understood in at least two different but complementary senses. It can consequently play different roles in human cognition, either directly, without any need to be mediated by any representation, as a physical body whose structures determine our species-specific motor and perceptual potentialities or, at a different level, as the object of conceptual and linguistic representations. To define these two different roles of the body in human cognition I will refer to a carefully developed distinction between the notions of body schema and body image. I propose that, at a first level, embodied cognition directly relies on body schemas while, at a second level, it relies on body images. Thus, depending on the level of analysis, i.e., the body schema or the body image, our body plays a different role in human cognition. In the first case, the contribution of the body to cognition is direct. This level of embodiment can give rise to embodied metonymic cognition. In the second case the contribution of the body is mediated by our cultural, environmentally situated and linguistically structured representations of the body itself. This is the level of embodied metaphorical cognition. Chapter 3 is a revised version of a previous book chapter[2] where the notions of body schema and body image where discussed and put in relation with the debate on metaphorical cognition. In the revised version of this work which is presented here the distinction between body schema and body image is fundamentally rediscussed in consideration of the definition of Embodied Simulation that is provided in Chapter 1 of this book. In this light, the connection between the notions of body schema and body image, on the one hand, and some central notions in the field of metaphor studies (e.g. the concepts of primary and complex metaphors), on the other, have been rediscussed, too.

To summarize, in the first three chapters of this book I address some central issues in the embodiment literature, provide an innovative account of the mechanism of simulation and discuss these topics in relation to the debate on conceptual metaphors and embodiment. These first three chapters can be regarded as a foundation on which to advance a controversial proposal in metaphor research to be discussed in Chapters 4 and 5. This proposal relates to the possibility, introduced by Steen (2008, 2011), that there may be a crucial distinction between deliberate and non-deliberate metaphor processing. I will propose that the deliberate processing of bodily metaphors modulate the activation of Embodied Simulation in a different way from the processing of non-deliberate body-related metaphors. In accordance with this proposal, I will provide a model of the processing of deliberate and non-deliberate metaphors.

Towards this aim, Chapter 4 will be devoted to a detailed discussion of Deliberate Metaphor Theory.[3] Apart from studying metaphor as a matter of thought and language, as has been customary since the cognitive turn initiated by Lakoff and Johnson (1980; Gibbs, 2008), Steen distinguishes a third dimension: metaphor in communication. This dimension serves many functions, but crucially highlights the difference between deliberate and non-deliberate metaphor use. The question is when and how metaphors are occasionally used *as* metaphors in communication between people, drawing attention to their nature as cross-domain mappings. This should be contrasted with the more frequent situation in which metaphors are not used as metaphors in communication but simply function as potential expressions of reconstructed underlying cross-domain mappings.

The difference between deliberate and non-deliberate metaphor use has been hotly debated in at least a dozen publications, including most notably Gibbs (2011a, 2011b and 2015a, 2015b, 2017a). The fundamental problem that

2. Valentina Cuccio. (2017), Body-schema and body-image in metaphor processing, in B. Hampe (ed.), *Metaphor: From Embodied Cognition to Discourse*, Cambridge University Press. ISBN: 9781107198333, reprinted with permission.

3. Chapter 4 is a guest contribution by Gerard Steen.

this debate has revealed for metaphor in discourse has to do with the question of when metaphors are processed as metaphors (Steen, Reijnierse and Burgers, 2014). As suggested by Steen (2008), there may in fact be a paradox of metaphor here: contrary to what is professed by many cognitive scientists, most metaphors may not be processed as metaphors in on-line comprehension, that is, through the construction or retrieval of cross-domain mappings in thought (Steen, 2008); all deliberate metaphors, by contrast, presumably do require such metaphorical processing. In the view of Deliberate Metaphor Theory, deliberate metaphors require a metaphorical mapping because deliberate metaphors, and only deliberate metaphors, force the speaker to pay attention to both the source and the target domains of metaphors in working memory during linguistic processing. Chapter 4 will first of all summarize the most important views of Deliberate Metaphor Theory and then argue that much of the presumed evidence for Conceptual Metaphor Theory can in fact be analysed as involving deliberate metaphor use, either in the materials or in the tasks. As a result, evidence for Conceptual Metaphor Theory can be recruited as evidence for Deliberate Metaphor Theory, which strengthens the case for Deliberate Metaphor Theory as an interesting alternative account of the way metaphor works in processing.

Chapter 5 will develop ideas about the neuroscientific basis of the cognitive grounding of deliberate and non-deliberate metaphors. A new model of metaphor processing will be proposed. This model will connect deliberateness in the processing of metaphors to an account of the interaction between attention and Embodied Simulation. An explanation will be provided of how the deliberate processing of bodily-related metaphors can modulate Embodied Simulation in specific ways. I will propose that the deliberate processing of bodily-related metaphors does not only trigger somatotopic activation in the brain but also determines a bodily attitude and the experience of specific bodily feelings (Foroni and Semin, 2009).

Attention has a key role to play in this process. Indeed, when metaphors are bodily-based and deliberately processed it is attention to the source domain that modulates the intensity and timing of the recruitment of the mechanism of simulation. This specific modulation of the mechanism of simulation leads to the activation of bodily sensations that subsequently have a direct effect on the processing of metaphors and their communicative effects. The way in which bodily sensations are activated and then needed at different moments of metaphorical language comprehension may vary between different types of language stimuli, including metaphorical versus non-metaphorical ones as well as deliberately metaphorical versus non-deliberately metaphorical ones (Cuccio et al., 2014).

This new account of the mechanism of Embodied Simulation and its relation to the notion of deliberateness will allow me to adopt a new and original position on the role of embodiment in metaphor processing. As was already anticipated, the mechanism of simulation can be specifically modulated by deliberateness during the processing of metaphors, and this leads to a modality of recruitment of this mechanism that is specific to metaphors that are processed deliberately.

For this book I am indebted to many friends and colleagues whose inspiring comments and criticisms have been fundamental to give shape to the ideas here presented. I certainly owe a lot of what I know in terms of metaphor and embodiment to Vittorio Gallese and Gerard Steen. The discussions with Marco Carapezza and his thought-provoking observations are present throughout the book. I wish to thank the people of the Metaphor Lab Amsterdam (especially, Marianna Bolognesi, Luzia Goldman and Gudrun Reijnierse) who hosted me from August to December 2015. My research activity in Amsterdam, as a member of the Metaphor Lab, crucially impacted on the final version of the book. I wish to thank Claudio Paolucci. His bright work and his friendship contributed, for many reasons, to the development of the project that led to this book.

This work was supported by the Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO – Netherlands Organisation for Scientific Research). The NWO grant for highly qualified senior researcher I was awarded in 2015 (grant number: 040.11.484) allowed me to stay in Amsterdam and write this book.

Last but not least, I am greatly indebted to Valerio. Without his love, encouragement and constant support, I would have never written this book.

CHAPTER 1

Embodied Simulation as bodily attitude

1.1 Introduction

Research on Embodied Cognition is a burgeoning field of study, with new findings offering us new tools for a better understanding of human cognition. Yet there are fundamental problems with embodied approaches to cognition. It is not even feasible to try and face all of the problems of this research paradigm, which, in addition, does not form a unified whole. My aim here will therefore be far more limited. I will focus on the mechanism of Embodied Simulation in order to achieve a deeper understanding of its contribution to human cognition and, as an important case in point, to the comprehension of metaphors (cf. Gallese and Cuccio, 2016; Cuccio and Gallese, 2018).

To define Embodied Simulation we need to go back to the discovery of mirror neurons (di Pellegrino et al., 1992). Mirror neurons are neurons in the premotor cortex[1] that are activated by both action execution and action observation. They become active when we perform an action or when we just observe someone else performing that same action, mirroring her actions in our motor system. To give an example, the motor areas in the brain that control the action of grasping a fork will be activated not only when we in fact grasp a fork but also when we see someone else grasping one. Motor circuits can thus be activated even though there is no overt action being carried out. This activation has been defined as a motor simulation.

Since the discovery of mirror neurons, it has been found that the mechanism of simulation is not limited to the motor areas. It is widespread in the brain and also characterizes brain areas that are involved, for example, in the processing of emotion and perception, affective states and interoception. Furthermore, the mechanism of simulation is not only activated by the observation of actions. It is also recruited by other cognitive tasks, such as concept formation (Gallese and Lakoff, 2005; Cuccio and Gallese 2018), mental imagery (Schendan and Ganis,

1. The premotor cortex is a combination of areas in the prefrontal lobe considered to be involved in the planning of voluntary movements (Purves et al., 2004).

2012), tool-use behaviour (Caruana and Cuccio, 2017), the enjoyment of works of art (Freedberg and Gallese, 2007; Sbriscia-Fioretti et al. 2013), social cognition (Cacioppo, Juan and Monteleone, 2017), learning by imitation (Buccino et al., 2004) and, most importantly for the purposes of this book, language comprehension (Pulvermüller, 2012). To give an example, the motor areas that control the action of grasping a fork will be activated not only when we in fact grasp a fork and when we observe someone else grasping a fork, but also when we see a fork, we read or listen to an utterance about someone grasping a fork, or when we imagine ourselves or someone else grasping a fork. The term Embodied Simulation has therefore come to be used to designate the mechanism of simulation independently of the brain area where it takes place and of the cognitive task it is recruited by (see Gallese and Sinigaglia, 2011 for a discussion).

In the current debate, scholars who support the idea that Embodied Simulation has a cognitive role to play mainly conceive of this mechanism as a modality-specific form of representation[2] (e.g., Barsalou, 1999, 2008; Clark, 1997; Gallese and Lakoff, 2005; Gallese and Sinigaglia, 2011; Glenberg and Kaschak, 2002; Glenberg, Witt and Metcalfe 2013; Goldman and de Vignemont, 2009; Lakoff, 2008; Meteyard et al., 2012; Pulvermüller, 1999; Zwaan, 2014). Barsalou is certainly one of the founders of this understanding of the mechanism of simulation. As Casasanto and Gijssels (2015) have pointed out, his influential paper on the perceptual symbol systems (Barsalou, 1999) has been cited more than 4,000 times. In this account our bodily experiences are implemented in modality-specific brain structures such as the visual cortex, the auditory cortex, the somatosensory cortex, the motor cortex or the olfactory cortex. Schematic representations of perceptual components of our bodily experiences can then be extracted and stored in specific forms in memory. For instance, as Barsalou explains (1999, 577), we can store in our memory the schematic representation of the individual memory of "green" (visual cortex), "hot" (somatosensory cortex) or "run" (motor cortex).

These representations, which are the building blocks of thought, are not abstract and amodal. They are, instead, encoded in modality-specific neural circuits. Thus, in this view, concept formation is deeply grounded in our bodily experiences and the symbols on which our mind operates are considered to have a perceptual origin. These symbols can be reactivated by means of the mechanism of simulation. The activation of this mechanism is hence basically conceived of as the occurrence of a modality-specific representation.

2. We will see later in the chapter that not all scholars in the field of Embodied Cognition agree with the definition of this mechanism in terms of simulation. For now it is important to note that researchers who define this mechanism in terms of simulation are also committed to a representational conception of it.

In the same vein, Goldman and de Vignemont (2009; see also Goldman, 2013) propose a representational definition of the mechanism of simulation that, in perfectly alignment with Barsalou's (1999) account, highlights the modality-specific nature of those representations. Goldman and de Vignemont's (2009) definition is, without any doubt, one of the most explicit and philosophically informed definitions of Embodied Simulation in representational terms that can be currently found in the debate. Indeed, the overtly declared purpose of these authors is to bring clarity to the embodiment debate by carrying out an analysis of some of the conceptions of embodiment currently available (Goldman and de Vignemont 2009, 154). In doing so, the authors directly address the question: "How would mental representations of or about the body enter the picture?" (Goldman and de Vignemont 2009, 154).

The answer they give is that the most suitable way for mental representations to enter the picture in the embodiment debate is under the label of what they call the "bodily format (B-format) interpretation". According to the authors, this interpretation of the notion of embodied mental representation may form the basis for the most promising account of embodiment that can be found at present. It is therefore useful to refer to the work of these authors because, as philosophers, they are highly aware of the theoretical implications of the use of the notion of representation. Moreover, their definition can easily be applied to much of the empirical work carried out on the mechanism of simulation (e.g., Barsalou, 1999, 2008; Clark, 1997; Gallese and Lakoff, 2005; Gallese and Sinigaglia, 2011; Glenberg and Kaschak, 2002; Glenberg, Witt and Metcalfe, 2013; Lakoff, 2008; Meteyard et al., 2012; Pulvermüller, 1999; Zwaan, 2014; and so on). Therefore, the results of a critical analysis of the notion of mental representation in bodily format, as defined by Goldman and de Vignemont (2009), can then be nicely applied to the theoretical implications of much of the empirical research carried out to date on the mechanism of Embodied Simulation.

Briefly, according to Goldman and de Vignemont (2009), there is a class of mental representations that is encoded in bodily formats. As they suggest, these formats can be *motoric*, whenever the representation is about bodily movements carried out with different effectors, for instance walking, grasping or kicking; *somatosensory*, whenever the representation pertains to events occurring at the body's surface, such as feeling heat or cold, sweating, and so on; *affective* or *interoceptive*, whenever the representation is about the physiological states of our bodies, as when we feel hunger; and so on. Following Goldman and de Vignemont's proposal (see also Goldman, 2013), the pattern of neural activation elicited by the action of grasping a fork or by the observation of that same action carried out by someone else is a mental representation, encoded in a motoric format, of the action of grasping a fork. If we then consider the mechanism of simulation as not being limited to motor areas of the brain, but rather as a more generally present mechanism in our brain, it could follow that we may also have mental representations in somatosensory format, affective format, visual format, and the like, as has been suggested by Gallese and Sinigaglia (2011). These representations are hence all modality-specific, since the specific neural circuits in which the representations take place determine their format or modality.

According to Goldman and de Vignemont, we can use these mental representations for social purposes, for example to ascribe the representation in bodily format to another person. Nevertheless, they also argue that this kind of representation, although very important for social cognition, is far from being exhaustive in explaining our social cognition (for a discussion of the role of the mechanism of simulation in social cognition see Jacob, 2008; Goldman, 2009; Spaulding, 2013). Three possible modalities of interaction between representations in bodily format and other factors involved in social cognition are sketched out by the authors and proposed for examination.

> (i) Some social-cognitive tasks could be executed by two or more methods, one involving B-formats and others involving other formats. (ii) Even the involvement of B-formats might occur at only one stage of a compound process, in which non-bodily formats predominate. (iii) Many social cognitive activities might involve no B-formats at all. (Goldman and de Vignemont 2009, 157)

As noted in the introduction, in the embodiment literature the notion of mental representation has been regarded as a demarcation line between radical and less radical embodiment theorists (Alsmith and de Vignemont, 2012; Chemero, 2009; Clark, 1997). On the one hand, radical embodiment theorists claim that we can explain how the human mind works without resorting to mental representations (Kelso, 1995; Port and van Gelder, 1995; Thelen and Smith, 1994; Van Gelder, 1995); on the other hand, exponents of moderate embodiment propose theories that include both representational and non-representational explanations of human cognition (Barsalou, 1999, 2008; Clark, 1997; Gallese and Sinigaglia, 2011; Goldman and de Vignemont, 2009). My aim here is not to argue in favour of radical or moderate embodiment theorists. Instead, I wish to propose arguments in support of a different thesis, namely that it is not legitimate to define simulation in terms of mental representations if we only consider the subpersonal dimension of this mechanism, as Goldman and de Vignemont (2009) and Barsalou (1999) seem to do.

The distinction between a personal and a subpersonal level of explanation of our experience was introduced by Daniel Dennett in 1969. According to Dennett, the personal level of explanation pertains to "the explanatory level of people and their sensations and activities". The subpersonal level, on the other hand, concerns "the level of brains and events in the nervous system" (Dennett 1969, p. 93). In other words, personal-level phenomena are those mental processes that characterise our lives as subjects while subpersonal phenomena are physical processes that we can describe in mechanical terms. In the light of this distinction, I propose that the phenomenon of Embodied Simulation, merely considered as a pattern of neural activation (a mental representation in bodily format, in Goldman and de Vignemont's words), does not meet the minimal requirements to be considered a representation.

In addition, I will claim that only if we keep the neural level and the phenomenological level together can we understand the cognitive role of Embodied Simulation (see Gallese and Cuccio, 2016; Cuccio and Gallese, 2018). In this line, echoing the distinction between the faculty of language in a narrow sense (FLN) and the faculty of language in a broad sense (FLB) (Hauser, Chomsky and Fitch, 2002), I propose that Embodied Simulation can be conceived, too, in a narrow sense and in a broad sense. Embodied Simulation in the narrow sense (ESN) refers, strictly speaking, to the activation of mirror or canonical neurons when we are not actively engaged in actions, perceptions or emotional experiences. Embodied Simulation in the broad sense (ESB) refers to the activation of this mechanism in a broader framework that comprises both other brain activities and content involving bodily features (bodily sensations and personal experiences) as opposed to merely neural ones. While the latter involves representational states, no representational account can be reasonably provided to account for the former. It is worth noting that to argue against any representational account of ESN, hence arguing against the notion of mental representation in bodily format (Goldman and de Vignemont, 2009), is not equivalent to embracing the radical approach to Embodied Cognition. The more comprehensive account of Embodied Simulation (ESN plus ESB) that will be here proposed may certainly be fully compatible with explanations of human cognition that imply representations.

In this chapter I will first discuss some of the problems raised by a representational account of ESN (Goldman and de Vignemont, 2009; Barsalou, 1999) (Section 1.2). As we have seen, these authors describe Embodied Simulation only as a subpersonal mechanism which triggers the arousal of patterns of neural activations, the latter being provided with representational properties. Simulations are, in this view, representations in bodily format that could be computationally manipulated. As an alternative, in Section 1.3, I will suggest that the only plausible way to describe the mechanism of Embodied Simulation is both to free this mechanism, in its narrow sense, from any representational load and to take into account the phenomenological dimension that comes into play when it is considered in the broad sense. As Gallese has already highlighted (2005, 43), the cognitive import of Embodied Simulation can be fully understood only if we bear in mind that this is a neural mechanism that also produces phenomenal states. The proposal advanced here is, thus, that in order to fully understand the role of Embodied Simulation in human cognition we need to take a broader perspective on this mechanism.

This being said, the first step to be taken is to offer some evidence that accounts of ESN cannot imply representational properties. I will therefore provide a non-representational account of this brain mechanism and, in so doing, will resort to the notion of information-sensitive responses to natural signs (Hutto and Myin, 2013, 78). This notion suggests that the behaviour of physical systems can be described in terms of variables in the systems that change in response to environmental states according to dynamic laws (Thelen and Smith, 1994). Physical systems are always embedded in their environment. States of the systems are continually changing in relation to changes in the environment and vice versa. In this account, there is no need to ascribe representational properties to physical systems. They co-vary with environmental states. Thus, on the one hand, the notion of information-sensitive responses to natural signs does not imply any content; on the other, embracing this contentless description of the mechanism of ESN does not necessarily commit us to also endorsing a fully non-representational description of its role in human cognition. Mental representations come into play when we have meaning and truth conditions, and this is not possible at the neural level.[3]

As Hutto and Myin (2017) have recently suggested in an updated account of their embodied approach to human cognition, basic cognition may not involve any content manipulation.

> According to REC (Radical Embodied Cognition), the basic sorts of cognition that our brains help to make possible are fundamentally interactive, dynamic, and relational. REC's signature view is that such basic forms of cognition do not involve the picking up and processing of information that is used, reused, stored, and represented in the brain. The usual form of what REC calls basic, contentless cognition is nothing short of organisms actively engaging with selective aspects of their environment in informationally sensitive, spatiotemporally extended ways. The complex and cascading neural activity that enables this engagement does not involve representing how things stand with the world, but only anticipating, influencing, and coordinating responses in a strong, silent manner. In promoting its peculiar bifold vision of cognition, Radicalizing Enactivism advanced a series of arguments. (Hutto and Myin 2017, xiv)

Interestingly, as the authors acknowledge, the fact that basic sorts of cognition are contentless does not exclude that some non-basic forms of cognition are contentful. They therefore propose that human cognition implies both contentless and contentful processes. Following this line of thought, I suggest that ESN does not involve any content. Nevertheless, if we aim to understand the cognitive role of

3. Even if this solution has been suggested (e.g Churchland, 1986), it is not legitimate to collapse this mental level with the neural level since, as yet, we do not have at our disposal any credible account of how to operate this form of eliminativist reduction.

Embodied Simulation we must take a wider perspective on this mechanism and contextualize the activation of Embodied Simulation in a broader framework that comprises both other brain activities and contentful bodily features. In my proposal, contentful types of cognition depend on brain activities whose description does not imply any commitment to representational content.

It is important to highlight that there is a fundamental difference between Hutto and Myin (2017)'s proposal and my own account of the mechanism of Embodied Simulation. Hutto and Myin (2017) propose a twofold vision of cognition. In their view, cognition consists of two kinds of processes: contentless cognitive process and contentful cognitive processes. Both are implemented in our brain activity. Brain activity does not involve content. Differently from Hutto and Myin (2017), I am not committed to embracing the distinction between contentless basic sorts of cognition (e.g., perception) and contentful non-basic sorts of cognition (e.g. language). I will only borrow from Hutto and Myin (2013, 2017)'s approach to embodied cognition their contentless description of brain activities, which, in their view, give rise to both contentless and contentful cognitive processes.

1.2 The problem of content

My aim in this section is to show that ESN cannot be accounted for through a representational description. When dealing with representational states we need to address what Hutto and Myin (2013, 57) – echoing Chalmers's (1995) famous expression, 'the hard problem of consciousness' – have named the 'hard problem of content'. Uriah Kriegel (2013, 173) has suggested that for a property to qualify as representational 'in the philosophically relevant sense', that property has to appeal to the notion of intentionality as conceptualized by Brentano. Representations always imply an intentional relation with an object (*aboutness*). This occurs independently of its real existence. Representations also always imply a representational content, what Brentano called *intentional inexistence of an object* (Brentano, 1874).

> Every mental phenomenon is characterized by what the Scholastics of the Middle Ages called the intentional (or mental) inexistence of an object, and what we might call, though not wholly unambiguously, reference to a content, direction towards an object (which is not to be understood here as meaning a thing), or immanent objectivity. In presentation something is presented, in judgement something is affirmed or denied, in love loved, in hate hated, in desire desired, and so on. (Brentano 1874, Eng. Transl. 1995, 88).

Philosophers have thus considered representations to be *intentional*, with a *t*, because representations are always directed toward something. In addition, they have also considered representations to be *intensional*, with an *s*, because representations have semantic properties (content, truth conditions, etc.).

It follows that the use of the notion of representation necessarily requires us to deal with the notion of content. In particular, we need to be able to clearly identify the content of our representations and to explain where the semantic properties of these representations come from. The latter problem, in particular, has been hotly debated in the field of philosophy of mind and different solutions have been proposed. Hutto and Myin (2017), for example, advance the hypothesis that representational cognition, and thus semantic properties, are acquired through cultural practices "involving public norms for the use of symbols" (Hutto and Myin 2017, 12). Language, in their perspective, is a clear example of representational cognition that we acquire only through cultural practices.

From an alternative perspective, much research has been carried out under the heading of the 'naturalization of content' hypothesis: this pertains to the possibility of ascribing original intentionality and semantic properties to merely physical states. This is the case, for example, of the mental representations in bodily formats (Goldman and de Vignemont, 2009) that were analysed in the previous section. Patterns of neural activation in the brain, in this hypothesis, can be considered to be mental representations susceptible of being computationally manipulated.

Hutto and Satne (2015) and Hutto and Myin (2013) review this debate and come to the conclusion that the accounts of natural content that have been provided so far, suggesting that representational content can already be ascribed at the level of neurons (e.g. Dretske, 1995; Millikan, 1984; Papineau, 1993), do not seem to have solved the problem. These accounts, in their view, are not plausible in many respects. Accepting this evaluation, we still lack a credible explanation of naturalized content (for a discussion see Hutto and Myin, 2013; Hutto and Satne; 2015, Kriegel, 2013). Developing this line of thought and taking seriously the criticisms that have been levelled at the project of the naturalization of content, we must conclude that authors that consider instances of the mechanism of ESN as mental representations (or, using the expression introduced by Goldman and de Vignemont 2009, as mental representations in bodily formats; see also Alsmith and de Vignemont 2012; Goldman 2012, 2013) should also be committed to providing a naturalistically credible account of the content of these representations. This account, however, is currently lacking.

By way of aside, it may be interesting to note that a critique of the notion of mental representation in bodily format has also been proposed, on different grounds, by Shaun Gallagher (Gallagher, 2007, 2008, 2015: see also van Elk, Slors and Bekkering 2010).

> Rather than a full-bodied account, it reduces embodiment to neural representations that are fully located within an individual's brain. It's a version of embodied cognition that does not involve the body per se. (Gallagher 2015, 41)

In addition to his criticisms of an account of Embodied Cognition based on the notion of mental representation in bodily format, which he claims seems to completely underestimate the notion of body, his papers (Gallagher, 2007, 2008, 2015) discuss the very conception of Embodied Simulation *as a simulation*. He argues that the neural mechanism designated by many as "Embodied Simulation" does not satisfy the criteria to be considered as a simulation. To be defined as a simulation, in Gallagher's view, a phenomenon should meet at least one of the two following criteria: (1) To be in a pretence state (the pretence definition of simulation); (2) To be a model that someone can use to do things or understand things (the instrumental definition of simulation). In his view, neither of these criteria is met by the neural mechanism of Embodied Simulation: it cannot pretend nor can it be accessed and freely used as a model. It follows, in Gallagher's argument, that this mechanism cannot be considered a simulation.

Gallagher's objections concerning the notion of simulation may be discarded in the alternative account of this mechanism that will be provided here. This is because the mechanism of simulation, when considered in the broad sense, will be defined as a phenomenon that engages the body in a sense of a body that is not merely neural. Embodied ESB determines a brain and a bodily state and, in particular conditions, it can put us in a pretence, or "as if", state. In particular circumstances, our bodily sensations, elicited by the mechanism of simulation, can even become a model we can access in order to understand others from a second-person perspective (Gallese and Cuccio, 2016; Cuccio and Gallese, 2018).

Below I will present this new account of the mechanism of ESB, which will be considered as a brain and a bodily attitude. However, I now first need to provide compelling arguments against the notion of mental representation in bodily format and, particularly, to show that authors proposing this notion lack a naturalistically credible account of the problem of content. This is what I will do in the following pages.

1.2.1 Representations in bodily formats

Goldman (2013, 101) holds the view that representations in bodily format are those that represent bodily matters from an internal point of view. In other words, Goldman (2013, 101) says that 'these are representations of inner senses rather than outer senses,' where the expression 'inner senses' stands for systems of inner bodily monitoring. To exemplify this concept, Goldman suggests that neural circuits encoding particular actions in the premotor cortex, such as holding or grasping, can be regarded as an internal representation of those actions in motoric format. In his view, these representations are needed during the real performance of actions and can then be exploited, by means of the mechanism of Embodied Simulation, to carry out other cognitive tasks different from their original use. A few lines later, Goldman explicitly addresses the problem of the content of these representations:

> Now, most bodily representations (and formats of representation) involve descriptive contents. That is, they have contents like 'Area A of my body is currently in state Σ, or is undergoing change G'. But some classes of representation have imperatival, or 'instructional', contents such as 'Effector E: move to the left' or 'Effector F: curl'. Motoric areas, in particular, have representational contents of the imperatival kind. Thus, the premotor and motor areas discussed by Pulvermüller utilize bodily codes the primary function of which is to send messages with imperatival contents. (Goldman 2013, 100–101)[4]

In this passage, Goldman (2013), describing the content of bodily representations, conflates two different functions. This is evident, for example, if we look at his description of the content of motor neurons. In accounting for the content of neurons in motor areas Goldman collapses motor command functions with these neurons' alleged function of representing information with relation to actions. That is, the activation of a neural circuit in the premotor cortex when we are carrying out an action is considered, in Goldman's view (2013), to be a representation in motoric format that has an imperatival content. To be more precise, the activation of a neural circuit in the premotor cortex when we are carrying out an action has, at one and the same time, a motor command function and the function of representing the commanded action. Representations in bodily formats, so conceived, can then be redeployed for different functions, Goldman says (2013, 102). For example, he continues, it has been shown that language comprehension makes extensive use of motoric representations.

> Such redeployments can be expected to result in the reuse of bodily formats – originally dedicated to ancient tasks – in the execution of new tasks, for example, the use of motoric representations for language comprehension. Pulvermüller's identification of a large circuit running from language areas to the motor and premotor cortices is an excellent example of the redeployment of an older (motoric) system, featuring a bodily format, to help execute tasks of language comprehension. (Goldman 2013, 102)

4. It is worth noting that in Goldman's account (2013, Goldman and de Vignemont 2009) both neural activations due to self-enacted experiences and to Embodied Simulation are considered to be representations in bodily format.

As is clear from this passage, Goldman's view is that the mechanism of simulation exploits representations in bodily formats, originally dedicated to certain old tasks, to carry out new, different tasks. If, by means of Embodied Simulation, we reuse a representation in bodily format, then the representational nature of the mechanism of simulation can be taken for granted. However, as suggested before, Goldman, in his definition of representations in bodily formats, seems to conflate motor command functions of neurons with the alleged function of these neurons to represent information. I hold that these two functions should not be conflated if we want to consider the activity of neural circuits as showing representational properties. Let me repeat the distinction. On the one hand, the role or function of any representation is that of 'saying or indicating that things stand thus and so, and to be consumed by other systems because it says or indicates in that way' (Hutto and Myin 2013, 62). On the other hand, in Goldman's view (2013), neurons in the premotor and motor areas of the brain have command function: they guide the system to perform some motor actions. To appreciate the distinction, we should reconsider what it means for neurons to have a command function.

When we perform actions, the activation of motor and premotor neurons is part of a complex process that can be completely described in physical terms. In physical devices, each distinct part or mechanism has a specific role in the encompassing action process. In this sense, neural circuits are not representational in nature. They seem to be structures that can causally influence each other (Ramsey 2007, xiv–xv). In these structures, neurons are connected to one another via synapses. When they are active, they transmit their activation to other neurons in their network. There is no content represented in this process. Rephrasing Dennett's (1987) expression, it is legitimate to say that the 'representational' stance, in these cases, is in the eye of the beholder.

If the activation of neural circuits in the motor and premotor cortex when we are carrying out actions does not have the proper function of representing these actions, how do things stand when we turn to Embodied Simulation routines? Do these have representational properties? For it could be objected that the physical and non-representational explanation described above cannot entirely be applied to the mechanism of Embodied Simulation. Since Embodied Simulation does not lead to the real performance of an action, the simulation could be regarded as a representation, at the neural level, of potential action (Gallese and Keysers, 2001; Goldman, 2013). This is the central issue that needs to be clarified.

A closer analysis of the mechanism of simulation (Spaulding, 2013) will help us pursue this goal. When we observe someone grasping a fork, this visual stimulus triggers the activation in our brain of the same areas of the premotor cortex that would be activated if we ourselves had performed the action. But we need to be more precise: if we perform the action, the activation of these areas in the premotor cortex is the first step of a process that will finally lead to the performance of the action. In the case of simulation, after the activation of the premotor cortex, an inhibition mechanism intervenes to stop this process (e.g. Brass et al. 2009; Cross et al., 2013). This inhibition mechanism will prevent us from parroting all actions and movements that we see. The latter unfortunately is the case in patients affected by echopraxia, i.e., the automatic imitation of other people's actions. This symptom characterizes patients affected by diseases such as Gilles de la Tourette syndrome, autism spectrum disorder and also those with frontal lobe lesions (Brandt et al., 2017). Clinical observation has suggested that echopraxia can be regarded as a disinhibition of the mirror areas through loss of suppression by the frontal lobe (Cross et al., 2013; De Renzi et al., 1996; Ghika et al., 1995; Lhermitte, 1986; Spaulding, 2013; for a review of the clinical implications of mirror neurons, see Rizzolatti et al., 2009). This means that, in the case of simulation, we have a potential motor act that would become executive if the process were not interrupted.

On a comparable note, we know that the mirror neuron system is involved in automatic imitative behaviour. We tend to automatically imitate other facial expressions, gestures or postures, and so on. This automatic imitative behaviour is not only a common and widespread feature in human sociality, but for different reasons it is also beneficial to social interactions. Automatic mimicry depends to a large extent on the activity of the mirror neuron system (Cross et al., 2013). This dependence has been demonstrated by a large number of studies, especially on Transcranial Magnetic Stimulation (TMS) (e.g., Baldissera et al., 2001; Borroni et al., 2005; Clark et al., 2004). In particular, when people observe an action, they exhibit increased cortico-spinal excitability of those muscles that are involved in the observed action and this effect of automatic attunement can be disrupted by means of magnetic impulses (TMS) being sent to areas of the premotor cortex, which form part of the mirror neuron system. Indeed, a disruption of the mirror neuron system's activity during action observation leads to a disruption of the automatic imitative behaviour. This involvement of the mirror neuron system in automatic imitation is a well-known phenomenon, and studies have also been conducted on the external mechanism responsible for controlling the tendency to automatic imitation (Brass et al. 2009; Cross et al., 2013), identifying the brain regions involved in imitation control and proposing models that show how these regions are engaged in the task of inhibiting automatic imitative behaviour.

There is a crucial implication of this research on automatic imitation in relation to Embodied Simulation and its definition in terms of mental representations. If we think of action circuits in physical terms as physical chains of neurons connected via synapses, the role that neurons in the premotor cortex carry out in the chain in which they are embedded does not differ, in the case of motor *simulation*, from the role they carry out in action *performance*. In other words, the activation of a motor programme in the premotor cortex, when triggered by one's own intention to perform an action or when triggered by action observation, is the same. In fact, we even need a control system to block the potential movement, preventing it from becoming executive; disruption in the control system will lead to the performance of observed actions and not just to their simulation. This is what happens, as we have seen, in the case of patients with lesions in the frontal lobe (Cross et al., 2013; De Renzi et al., 1996; Lhermitte, 1986). This means that there is no qualitative difference between the neural activation that occurs during Embodied Simulation and the activation that is observed during action execution: the role of these neurons in the circuit is exactly the same (a quantitative difference between the two conditions is more likely). The fact that we need to inhibit a potential movement from becoming effective is in itself proof of the fact that neurons in the premotor cortex are just carrying out the role they usually play in the circuit. These neurons are merely activating other neurons to which they are connected via synapses.

If we then limit ourselves to the observation of the activation of a specific neural circuit (e.g., the "grasping" circuit) during simulation, its function seems to still be that of activating the parts of the system to which it is connected. Hence, to really understand the difference between the role of this neural circuit during simulation and during action execution we need to look at the system as a whole. This means that in order to understand the mechanism of Embodied Simulation we need to broaden the focus of our attention. We cannot isolate some neural circuits in a circumscribed area of the brain and claim that they represent action information because the proper function of neural circuits can only be understood when we consider how these neural circuits influence the rest of the system. Thus, we also need to see which other areas and which other neural structures can be activated as a result of the activation of the mechanism of simulation and also what this entails at the behavioural level. In other words, we need to know in which broader context the activation of the mechanism of simulation takes place.

I therefore propose that it is an error to interpret the fact that identical patterns of neural activation accompany the act of grasping a fork and watching someone grasping a fork as evidence that the patterns of neural activation represent the simulated action. Instead I propose that only by looking at the entire system can we understand the difference between the role of identical patterns of neural activation occurring in different situations (e.g., during action execution and action observation).

Furthermore, it is worth remembering that today we have techniques and methodologies of research that allow us to separately investigate different levels of our experiences. This has mistakenly led some researchers to consider neural activations and personal-level experiences as two separate things to the extent that we consider one level, the neural one, as representing the other, the behavioural one. However, neural activations are part of the process of constituting our experiences. It does not follow from the fact that we can separately investigate aspects and levels of our experiences that we can consider patterns of neural activation as representing behaviours. Neurons are simply one part of the process and we should not isolate them from the rest of the process and expect them to do all the work. In other words, we cannot ascribe to a part of a process what is the outcome of the full process.

The arguments discussed in this section suggest that ESN, i.e. Embodied Simulation merely considered as the activation of a neural circuit, for example, a motor circuit or a somatosensory circuit, in the absence of a corresponding action or sensation, cannot be defined as a mental representation. In the next section an alternative account for this mechanism will be presented. In this account, the mechanism of simulation will be discussed in the light of its possible connections with other brain structures and of its contribution to personal-level experiences.

1.3 Embodied Simulation as bodily attitude: Getting attuned to the world

An increasing number of empirical studies suggests that Embodied Simulation plays an important role in many aspects of cognition, ranging from action understanding to language comprehension, from the structuring of our conceptual system to the enjoyment of works of art. However, the specific role of Embodied Simulation is still unclear. The current debate mainly describes Embodied Simulation as a modality-specific representation taking place at the neural level but I have provided arguments that ESN cannot qualify as a representation. I suggest that the neuro-centric definition does not tell us the whole story because it neglects the role of the body as a non-neural entity. I am therefore proposing an innovative account of the mechanism of Embodied Simulation in which, alongside the neuro-centric narrow perspective, there is also and necessarily a broader conception in which Embodied Simulation does not only set a brain disposition but also a bodily attitude which is then recruited to solve some of the cognitive tasks we need to face (Gallese and Cuccio, 2016). Embodied Simulation, in this view, cannot be explained and fully understood if we limit ourselves to observing circumscribed patterns of neural activation. On the contrary, we need to consider the entire process of simulation in all its complexity, starting from the neural level and going on, in particular conditions, to the personal level of bodily sensations and dispositions.

To understand more deeply how Embodied Simulation works it is useful to look at one of the first studies to show the existence of the mirror neuron system[5] in the human brain (Fadiga et al., 1995; this study has been widely replicated, see: Aziz-Zadeh et al., 2002; Borroni et al., 2005; Gangitano et al., 2001; Maeda et al., 2002; Strafella and Paus, 2000; Urgesi et al., 2006). Fadiga et al. (1995) stimulated the motor cortex of normal subjects using Transcranial Magnetic Stimulation (TMS) in four different conditions: (1) participants observed an experimenter grasping an object; (2) participants looked at the same object; (3) participants observed an experimenter tracing geometrical figures in the air with his arm; (4) participants detected the dimming of a light. Motor Evoked Potentials (MEPs) were recorded from hand muscles. Activity in the same muscles was also recorded by means of electromyography (EMG) during rest, action execution (grasping) and arm lifting. The findings of this study showed that the MEPs pattern recorded during action observation reflected the pattern of muscle activity recorded when the subjects executed the observed actions. The hypothesis behind this study was that the activation of neurons in the premotor cortex, elicited by action observation, could in turn elicit the below-threshold activation of executive neurons in the primary motor cortex. It was, thus, hypothesized that a magnetic pulse sent during action observation could amplify the activation of executive neurons in the primary motor cortex, leading them to cross the threshold of activation that has to be traversed to activate motor neurons in the spinal cord. Motor neurons in the spinal cord would have, then, activated muscular fibres. This hypothesis was confirmed by experimental results, with the study clearly showing how the motor cortex is involved in the mirroring mechanism.

Findings from Fadiga and colleagues' (1995) study suggest that there is more going on during motor simulation than just the activation of the premotor cortex. More precisely, as highlighted by Cross et al. (2013, 493) "observing actions causes sub-threshold activation of the imitative response". Most importantly, particular cognitive tasks involving attention to action features or specific conditions characterized by, for example, strong emotional involvement, can also amplify the simulation effect, thus leading to genuine muscle activation and, crucially, to the experience of bodily sensations.

Interestingly, empirical data seem to converge towards this conclusion, even though their theoretical import has not as yet been sufficiently taken into

---

5. It is worth recalling that the mechanism of Embodied Simulation is not limited to the activation of mirror neurons during action observation nor is it circumscribed to the motor cortex. The mechanism of Embodied Simulation is also activated by other cognitive tasks such as language understanding and mental imagery and characterizes other areas of the brain such as, for example, those involved in the experiencing of emotions.

consideration. In a functional Magnetic Resonance Imaging (fMRI) study, Costantini et al. (2005) observed the potential simulation elicited by both possible and biomechanically impossible movements of fingers. The authors of this study found that both conditions activated the premotor areas, thus leading to a simulation even of the biomechanically impossible movement. However, there is another result of this study that is extremely interesting from our point of view. Data from Costantini et al.' (2005) experiment showed the activation of the Posterior Parietal Cortex (PPC), an area of the brain that is involved in the processing of bodily sensations, in both experimental conditions. However, this area was significantly more activated in the biomechanically impossible movement condition. As anticipated, particular circumstances (attention, emotional involvement, pain or pleasure, etc …) can amplify a simulation effect (Abreu et al. 2012; Costantini et al. 2005). The stimulus showing a biomechanically impossible movement seems to function in this way, determining this amplifying effect. Indeed, as is clear from observing some of the selected superimposed frames from the video sequences of finger movements (see Figure 1 below), participants in the impossible movement condition of the study watched video clips showing a hand undergoing an unnatural and potentially extremely painful movement. As a result, the simulation did not confine itself to the motor areas but also involved areas related to the experience of bodily sensations to the extent that participants in the studies reported having felt "sensations" determined by the observation of the experimental stimuli:

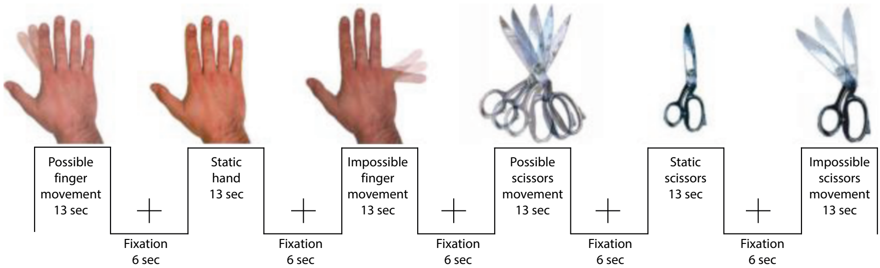

Figure 1. Experimental stimuli used by Costantini et al. (2005). Only the two hand movements conditions are here discussed as relevant for the current proposal on the definition of the mechanism of simulation.[6]

> The second main result of the present study was that the PPC (Brodmann's areas 40 and 7) was significantly more active during the observation of impossible than possible hand movements. This activation was probably due to the crucial

6. Figure 1, from Costantini, M., Galati, G., Ferretti, A., Caulo, M., Tartaro, A., Romani, G.L., & Aglioti, S.M. (2005) Neural systems underlying observation of humanly impossible movements: an FMRI study. *Cereb. Cortex*, 15, 1761–1767, is reproduced by permission of Oxford University Press.

> role played by the PPC in the sensorimotor transformations that link world-related and body-related sensations to action execution (Andersen et al., 1997; Freund, 2003). Moreover, this activation suggests that PPC regions play a crucial role in determining whether the observed movement can actually be performed. (Costantini et al. 2005, 1765)

> All of the experimental subjects reported that observation of impossible hand movements induced a variety of sensory feelings ranging from aversion to the sensation of joint stretch. (Costantini et al. 2005, 1766)

The observation of the impossible hand movements in this experiment determined a significantly stronger activation of an area of the brain that is involved in the processing of bodily sensations (the Posterior Parietal Cortex, PPC), although this area was found to be activated in the biomechanically possible condition, too. The arousal of this area, as a consequence of the activation of the mechanism of simulation that, as suggested before, "causes sub-threshold activation of the imitative response" (Cross et al. 2013, 493), determined the real experience of bodily sensations, ranging from aversion to joint stretch, that were overtly reported by participants of the study.

Analogous results have been found by Abreu et al. (2012). In an fMRI study, these authors studied, in expert basketball athletes and novices, the ability to predict the outcome of free throws performed by others. Clearly, the ability to predict other's actions is fundamental in social contexts, both in our everyday life and, particularly, in competitive contexts such as sport. In the latter case, this ability, the authors say, allows athletes to anticipate rather than merely react to opponents (Abreu et al. 2012, 1646). As I will discuss further in the following pages, previous studies (see Abreu et al., 2012 for a review) have suggested that, in predicting what others are doing, we recruit our own motor system. In the Abreu et al.'s (2012) study, the authors investigated (a) whether other neural regions are also involved in predicting others' actions and underpin this ability and (b) whether differences can be detected between expert athletes and novices.

The experimental task in this study required participants to observe video clips showing basketball players performing free throws. Video clips were edited in such a way that movies ended at the frame before the ball completed its trajectory. Participants did not see the outcome of the shot in the video clips. Three outcomes were possible: the ball could hit the basket, it could fall short of it or it could fall beyond it. Participants were asked to predict the outcome of the free throws. The task thus required them to pay specific attention to the action features carried out by the basketball players in the short movies.

Abreu et al. (2012) found that in both expert basketball players and novices, the observation of the experimental stimuli led not only to the recruitment of the mirror system and, hence, to motor simulation, but it also determined the activation of the sensory cortex:

> […] common to both expert and novice observers was the observation of activity in the primary somatosensory cortex (S1). It is plausible that motor simulation may imply mapping of specific sensory features of the observed actions (Costantini et al., 2005), independently of expertise. (Abreu et al. 2012, 1652)

In other words, bodily sensations were directly recruited in facing the cognitive task the participants were asked to perform. And this is a result of the specific task performed.

It is not being claimed here that ESB indiscriminately determines the activation of the bodily sensations we are always conscious of. Consciousness is not necessarily involved. However, it is very likely to be involved in particular circumstances that imply attention, emotions, pain or pleasure, etc. In other cases, Embodied Simulation can prepare us for an action we can potentially carry out without arousing conscious bodily sensations that we can actually feel. In this case, the cognitive role of simulation is to "suggest" to us the right action, preparing our motor system to perform it. This could be case, for example, in some tool-using behaviours. Caruana and Cuccio (2017) have recently discussed the role of the mechanism of simulation in preparing us to perform actions that require tool use. They argue that the activation of our motor competence through the mechanism of simulation allows us to account both for the initial selection of tools and for their actual use. In fact, the retrieval of a simulation routine, determining the activation of the motor programme for tool use, leads us to select the tool and to generate use behaviour. Nevertheless, even though conscious bodily sensations are probably not aroused in every single occurrence of a simulation routine, they are certainly recruited in many circumstances, particularly when we interact with others and when attention, emotion or pain and pleasure are involved.

As briefly anticipated in the previous pages, the study by Abreu et al. (2012) is consistent with the hypothesis that the mirror system is a core mechanism of a predictive coding framework (Kilner, Fristion, Frith, 2007) that allows us to understand other people's action. This predictive process is also supported by the experience of bodily sensations. These can sometimes be consciously felt, especially when we are observing actions we ourselves have extensive experience of.

> Correct action prediction induced higher posterior insular cortex activity in experts and higher orbito-frontal activity in novices, suggesting that body awareness is important for performance monitoring in experts, whereas novices rely more on higher-order decision-making strategies. (Abreu et al. 2012, 1646)

To deepen our understanding of the mechanism of simulation and determine what its role could be in such a predictive coding framework, we need to go a step further and broaden the focus of our attention. We need to go from conceiving of Embodied Simulation in a narrow sense, i.e., considered to be the activation of a circumscribed neural circuit, for example a motor circuit in the absence of a corresponding action, to conceiving of Embodied Simulation in a broad sense. The latter approach will force us to contextualize the activation of this mechanism in a broader framework that comprises both other brain activities and contentful bodily features (bodily sensations and personal experiences) as opposed to merely neural ones.

It is currently widely accepted that the brain is able to elaborate 'predictions' of the sensory consequences of well-known and practised actions (Miall and Wolpert, 1996). These 'predictions' are initiated in the motor cortex that sends inputs to the sensory cortices such that the sensory cortices can anticipate the sensorial feedbacks usually associated with familiar actions. For example, when we start the action of grasping a fork, our own movements produce sensory inputs. We feel some bodily sensations that are the results of the action we are carrying out. This is because our brain is equipped with a predictive coding framework that allows activation of the somatosensory cortex, the latter determining bodily sensations, by inputs sent from the motor cortex in such a way that the reafferent sensorial feedbacks (i.e. the incoming sensory signals that are produced by an organism's own motor output; Pynn and De Souza 2013) will be activated ('predicted') even before we really get these feedbacks from our environment.

The inputs sent by the motor cortex have been described as internal copies of the motor output and have been named 'efference copies' (Niziolek et al., 2013; Sperry, 1950; von Holst and Mittelstaedt, 1950). It has been shown that during action execution this model or anticipation of sensorial effects is constantly updated by real sensorial feedback (Pynn and DeSouza, 2013) and that this contributes to our potential for action and perception (Pynn and DeSouza, 2013). In fact, the anticipation of various kinds of sensorial feedback allows the motor system to respond appropriately to and regulate situated actions and to increase the efficiency of sensorial signal processing. Unless the predictions are disconfirmed, only relevant sensorial signals will be processed and receive our attention. To give an example, when we perform the action of grasping a fork, this familiar action activates the predictive coding framework: the motor cortex sends inputs to the somatosensory cortex so as to anticipate the inputs we will get by carrying out this action and the consequent bodily sensations.

This mechanism makes our actions unfold smoothly and more efficiently. In fact, the sensorial feedbacks our brain is able to anticipate are constantly updated by real sensorial feedbacks. In this way, if the brain's predictions are not disconfirmed (i.e. if these predictions correspond to the real inputs we receive when we carry out the action), the predictive mechanism will allow us to expend less cognitive effort by paying attention only to relevant sensorial inputs. Otherwise, if something goes wrong (i.e. if the brain's predictions do not correspond to the real inputs we receive by carrying out the action), we are able to adjust our movements to the new situation.

The mirror neuron system has been explicitly connected to these models of motor control (Carr et al., 2003; Iacoboni, 2003; Kilner, Friston and Frith, 2007; Miall, 2003). It has been hypothesized that the activation of neurons in the premotor cortex, not only during the execution of real actions but also during Embodied Simulation, determines the activation of 'efference copies', which will then make available to us an anticipation of the possible sensorial effects of the observed action. In other words, the activation of the mirror neuron system leads to a 'prediction' of the sensory effects of a potential movement. To be more precise, following Iacoboni (2003) and Miall (2003), we can suggest that the mirror neuron system lies at the interface between two systems for motor control: during action observation, the activation of the mirror neuron system leads, on the one hand, to the construction of an 'inverse model' that allows us to convert visual information into a motor plan; on the other hand, the mirror neuron system leads to the activation of a 'forward model' that allows us to convert the motor plan into the sensory outcome of the potential action. 'Efference copy' signals of a potential motor command, activated by the Embodied Simulation mechanism, travel to the appropriate sensory cortex, giving rise to 'predictions' in visual, auditory, somatosensory or proprioceptive modalities.

In simple terms, the activation of the mechanism of Embodied Simulation, for example during action observation or the processing of an action-related sentence, determines the activation of the motor cortex (this is the so-called "inverse model" that allows us to transform visual, linguistic or other kinds of inputs into a motor plan). The motor cortex will then send inputs (efference copies) to the somatosensory cortex determining the anticipation of reafferent sensorial feedbacks (i.e., the prediction of the sensory feedbacks we would feel if we were ourselves performing the action we are observing; this is the so-called "forward model"). These 'predictions' can be defined in terms of a modulation in the activation of the sensory cortex according to the requirements of each sensory network. If incoming sensory information does not match the expectations, the forward model will be able to re-modulate the sensory cortex, updating the sensory cortex response to the real sensorial stimuli (Pynn and DeSouza 2013, 125–127).

In this connection, it has recently been suggested that dysfunction in the 'efference copy' signals (e.g., failure to disambiguate self-induced from externally generated sensory input) could be the cause of some of the symptoms (auditory hallucination or delusion of passivity) displayed by schizophrenic patients (Pynn and DeSouza, 2013). This means that 'efference copy' signals lead to the experience of bodily sensations to the extent that their dysfunction can determine distorted sensations (hallucinations, etc.). For example, a schizophrenic patient could imagine performing an action. Mental imagination will, thus, activate the mechanism of simulation which, in turn, will trigger the predictive coding framework, thus producing an anticipation of the sensorial feedbacks the patient would get from his own action if he was really performing it. A dysfunction of the predictive coding framework, however, will make the patients unable to compare and distinguish the self-induced bodily sensations with real sensory inputs coming from outside. As a consequence, this will lead to the experience of hallucinatory sensations.

Accordingly, the mechanism of simulation can be regarded as the core mechanism of a predictive coding framework, as has already been suggested (e.g., Kilner, Fristion, Frith, 2007), allowing us to understand other people's actions and to face many other cognitive tasks by relying on the 'predictions' of sensory outcomes. In this regard, the mechanism of simulation, by triggering the predictive coding framework, seems to be able to determine bodily dispositions and sensations. And, under typical conditions, we do not confuse these self-generated sensations with sensations generated by real external sensory inputs.

These bodily dispositions and sensations are directly involved in the cognitive task being carried out. In fact, the physical body and its states have been considered to play a direct role in cognition, closely affecting our cognitive processes (Gallagher, 2015). Embodied Simulation, in this view, does not only determine the activation of brain states susceptible of being described in mechanical terms. It also determines the real experience of contentful states of our physical, not merely neural, body. The mechanism of Embodied Simulation is, hence, part of a broader process that keeps together both the subpersonal and the personal levels of experience, i.e., the neural level and the level of bodily sensations.

As we conclude this section, there is a final problem we need to face. At this point it could still be objected that there is a fallacy in the argument proposed in the previous pages. While I argued against using the notion of representation to define ESN in Section 1.2, by using the theoretical concepts of forward and inverse models and of 'efference copy' in Section 1.3 I might be accused of having surreptitiously reintroduced a representational vocabulary into the discussion to describe neural mechanisms. Terms such as 'prediction', 'representation', 'model' and so on abound in the debate on motor control and some of them have consequently been used in the previous pages. In this regard, it is important to consider that in certain circumstances it is not possible to avoid the use of some terms, especially since, as in this case, these are part of a highly codified and specialized language. However, as it is the case in Hutto and Myin (2017), the use of these terms does not necessarily commit us to qualifying the terms as denoting truly contentful and representational entities. In line with Hutto and Myin's (2017) usage of the predictive processing terminology, these terms are considered here to not entail any contentful dimension.

Furthermore, and this is most important, it is possible to provide a non-representational account of the learning process that allows the motor system and also other systems (vision, for example) to elaborate predictions (e.g. Dreyfus, 2002). Today we have valuable models that can explain how our past experiences can affect our present performances without any need to resort to the notion of representation at the brain level. Hubert Dreyfus (2002, 374), for example, describes the so-called 'feed forward simulated neural network'. This model is based on the idea that 'training' can modify the strength of the connections between neurons. Thanks to these connections, when receiving inputs, neurons can produce outputs based on past experiences.

By way of aside, this model is not just a new version of associationism based on simple stimulus–response patterns. In fact, outputs do not merely depend on association with specific inputs as in conditioning. Outputs also, and most of all, depend on the initial state of the system, i.e., its state of activation at that particular moment. Neural networks models are not pushing us back to an old-fashioned black box model of the mind. Sophisticated neural networks can model the brain and suggest how it is able to learn. In this regard, the activity of the nervous system, as suggested before, can be explained in physical terms and by having recourse to the notion of informational sensitiveness (Hutto and Myin 2013, 81–82). Informationally sensitive systems, relying on the exploitation of co-variation relations, do not imply any representational content.

By exploiting correspondences between brain states and states of the environment our nervous system can even learn how to 'predict' our sensory outcomes. The 'predictions' realized by the forward and inverse models can be regarded as the product of the acquisition of co-variance relations. From this point of view, we are a highly sophisticated physical device that leads to the emergence of cognitive life (see Searle, 1997 on the notion of emergent properties). The body, considered as the place of both biological processes and lived experiences and sensations, has a crucial role in this transition. If we do not take into account the non-neural aspect of the body, we really have little chance of understanding the contribution embodiment makes to cognition.

It is interesting to note that the predictive coding framework has been at the centre of recent attempts to provide an embodied account of cognition (Clark 2016a, 2016b, 2016c; Hutto and Myin, 2017; see also Hohwy, 2014). Predictive Processing accounts of Cognition are today being hotly discussed and are influential in the embodiment debate. The writings of Hohwy (2014), Clark (2016a, 2016b, 2016c) and Hutto and Myin (2017) are unquestionably innovative and stimulating in this regard. Clark (2016a, 2016b, 2016c)'s and Hohwy (2014)'s proposals seem to be still committed to a partly cognitivist, and thus representational, description of the activity of the predictive coding framework, at least in Hutto and Myin's (2017, 72, 74) interpretation of their works. The latter authors, instead, explicitly aim to provide a fully contentless description of the embodied expectations that our brain enables:

> [...] although we have ample reason to think that brains play a central role in enabling embodied expectations, we have no grounds to suppose that the brain does its important work by modeling or describing anything at all.
>
> (Hutto and Myin 2017, 74)

The proposed account of the mechanism of Embodied Simulation as the core mechanism of a predictive coding framework is, hence, in line and fully compatible with Hutto and Myin (2017)'s explanation of the non-representational nature of the predictive mechanism of the brain.

Finally, it is also important to underline that the considerations proposed so far are based on the discussion of Embodied Simulation taking place in the motor modality and elicited by action observation. However, these considerations can be extended to other occurrences of simulation routines taking place in different modalities and during other cognitive tasks. To give an example, Foroni and Semin (2009) argue that the processing of verbs referring to emotional expressions (e.g., *to smile*) elicits facial muscle activity as normally elicited during both the production and the observation of facial expressions (e.g., a smile). Thus, their study suggests that emotion-related language directly recruits our bodily dispositions, in a sense of the term that is not just neural.

As is now generally accepted, Embodied Simulation during language comprehension suggests that meaning is constructed, in many cases, on a bodily basis, but the present account crucially adds that the role of the body in this process is direct and not mediated by a representation. In other words, language comprehension seems to not merely activate subpersonal representations of the body. It recruits the physical, and not merely neural, body in determining the experience of bodily sensations. In this view, Embodied Simulation, taken in the broad sense, provides us with a brain and bodily disposition that is necessary, although not sufficient, for understanding action, perception or emotion-related language (Wojciehowski and Gallese, 2011).

To give a sneak preview of the later chapters in this book, this should be particularly evident in the case of metaphors (Cuccio, 2015b). It will be proposed that bodily-based metaphors, usually pervasive in our language (Lakoff and Johnson, 1999), can become communicatively successful exactly because they presumably exploit this mechanism of brain and bodily attunement, which is realized by means of Embodied Simulation (Cuccio 2015a, 2015b). I will propose that this is especially the case when these metaphors are deliberately attended, despite their being cognitively more expensive. In fact, I will argue that the way deliberate metaphors modulate attention directly affects the extent to which ESB is recruited by language processing.

In this chapter I have presented ESB as a key point for an account of embodiment that brings together brain states and bodily experiences. The cognitive role of this mechanism can be understood only if we bridge the gap that goes from subpersonal, physical phenomena to personal-level experiences. To do so, we should not limit our observation to the activation of isolated neural circuits in a circumscribed brain area but must also take into account what happens in other brain structures and, importantly, at the personal level of experience. By broadening the focus of our attention, we can see how bodily dispositions and sensations come into play. These bodily dispositions and sensations can be regarded as an integral part of the phenomenon of simulation which is, thus, not merely neural.

As we have seen, neural activations and personal-level experiences are often mistakenly considered to be two separate things. It is worth remembering again that neural activations are just part of our experience and that it does not follow from the fact that we can separately investigate aspects and levels of our experiences that we can consider patterns of neural activation as representing behaviours. Neural circuits per se do not have original intentionality. At this point it is only legitimate to say that neural activations are part of the process that leads to personal-level experiences and that they co-vary with behaviours. But it is not legitimate to claim that neurons in themselves have content and represent.

1.4 Conclusion

In this first chapter I have provided arguments against a representational account of ESN and I have developed an alternative account in which this mechanism is described as a complex phenomenon that sets a bodily attitude and often makes us able to re-enact or simulate in our own body sensations and experiences observed in others or invoked by linguistic processing, mental imagery, etc. These bodily sensations contribute to solving many of the cognitive tasks by means of which the mechanism of simulation is recruited and are thus an integral part of Embodied Simulation. This bodily and not merely neural component of the mechanism of simulation allows us to bridge the gap that goes from the level of neurons to the personal level of experience and helps us to understand the specific cognitive contribution provided by Embodied Simulation. In this way, we can progress from neurons to mental representations, as this book aims to do.

In the rest of this book, I will apply this account of Embodied Simulation to the current debate on embodied cognition and metaphors in language, thought and communication in order to disentangle some of the issues currently under discussion. In the following chapter I will provide an overview of recent developments in Conceptual Metaphor Theory (CMT) related to the discovery of mirror neurons and of the mechanism of Embodied Simulation. I will show how this discovery has been received in the field of metaphor studies and I will suggest that the current proposal for a new account of Embodied Simulation allows me to adopt an original and innovative position in this debate.

CHAPTER 2

The embodied turn

The Conceptual Metaphor Theory after the discovery of mirror neurons

2.1 Introduction

In this chapter I will provide a brief overview of the impact that neuroscientific findings on the role of Embodied Simulation in language processing have had on CMT. As one of the founding fathers of CMT, George Lakoff made it clear in his earliest writings (Lakoff, 1987, 1993; Lakoff and Johnson 1980) that there are two main hypotheses in CMT: (1) metaphor is a matter of thought; (2) metaphor is a central phenomenon in our everyday life. According to Lakoff, these hypotheses directly contradicted what classic theories of metaphor had proposed up until that point, i.e., that metaphors are mainly poetic forms of language in which words are used with unconventional meanings, the unconventional reference being built on the basis of analogical relations. Lakoff differed in viewing metaphors as primarily a cognitive mechanism: their linguistic expression is a by-product of their conceptual nature. Being conceptual in nature, metaphors are not confined to poetry. We make use of metaphors every day to conceptualize complex, abstract and problematic concepts.

CMT takes metaphors to be mappings between two conceptual domains (see also Gibbs 2006a; Kövecses, 2008). Thanks to these mappings, we typically understand and make sense of more abstract concepts by relying on more concrete and familiar bodily experiences. LOVE IS A JOURNEY is a classic and widely discussed example in CMT in which the abstract concept of love, the target of the metaphor, is understood and conceptualized via the physical experience of travelling, the source of the metaphor. The linguistic descriptions of aspects of love relationships discussed by Lakoff (1993, 204; see also Lakoff and Johnson, 1980) are offered as evidence for this conclusion:

> Look how far we've come. It's been a long, bumpy road. We can't turn back now. We're at a crossroads. We may have to go our separate ways. The relationship isn't

going anywhere. We're spinning our wheels. Our relationship is off the track. The marriage is on the rocks. We may have to bail out of this relationship.
(Lakoff 1993, 204)

CMT has provided numerous examples over the past forty years both in terms of linguistic analyses of conceptual metaphors and in terms of psycholinguistic experiments showing activation of both source and target domains in the participants conceptual system (Gibbs 2006a, 2006b, 2011b for a review).

With regard to linguistic analyses, since Lakoff and Johnson (1980) published their work, conceptual metaphors such as ARGUMENT IS WAR, ARGUMENTS ARE BUILDINGS, TIME IS MONEY, TIME IS A RESOURCE, IDEAS ARE FOOD, IDEAS ARE OBJECTS (see Reddy, 1979 on the conduit metaphor), HAPPY IS UP, MORE IS UP, THE MIND IS A MACHINE, THEORIES ARE BUILDINGS, LOVE IS A JOURNEY, LOVE IS A WAR, LOVE IS MADNESS, EMOTIONAL EFFECT IS PHYSICAL CONTACT, LIFE IS A CONTAINER, LIFE IS A JOURNEY, UNDERSTANDING IS SEEING and many others have been extensively studied in thousands of publications in different languages all over the world (see Hampe, 2017 for an overview of previous studies and recent developments in CMT). The observation of a huge amount of linguistic data has thus allowed conceptual metaphor theorists to conclude that conceptual metaphors are the origin of systematic and coherent sets of linguistic metaphoric expressions that we constantly use in our everyday life. The ARGUMENT IS WAR metaphor, for example, has been observed to give rise systematically and consistently to expressions such as (Lakoff and Johnson, 1980):

Your claims are *indefensible.*
He *attacked every weak point* in my argument.
His criticisms were *right on target.*
I *demolished* his argument.
I've never *won* an argument with him.
You disagree? Okay, *shoot!*
If you use that *strategy,* he'll *wipe you out.*
He *shot down* all of my arguments.

The rationale behind the analyses of this massive amount of linguistic data in the last forty years has been the idea that the structure of language reflects the structure of thought. The pervasiveness of metaphorical expressions in our language has been considered as proof of the fact that we think metaphorically.

However, linguistic data *per se* might not be sufficient to permit the inference that our concepts are metaphorically organized. For this reason, psycholinguistic research supporting the core tenets of CMT has been carried out (but bear in mind that Casasanto 2009, 127 has warned us that "there are both *in principle* and *in practice* reasons why we cannot infer the structure and content of non-linguistic mental representations based solely on linguistic and *psycholinguistic data*"). Findings from numerous empirical studies have suggested that abstract and complex domains in our conceptual system are usually structured via a metaphorical mapping from more concrete and simple ones. And this seems to hold true even when we are not using any metaphorical expressions in our linguistic exchanges, as is also suggested by behavioural and neuroscientific research. The following excerpt from Casasanto and Gijssels (2015) provides an excellent overview of some of the psycholinguistic research carried out in the field of metaphor studies:

> Metaphors aren't just ways of talking, they are ways of thinking. This claim, the central message of Conceptual Metaphor Theory (Lakoff and Johnson 1980, Lakoff and Johnson 1999), was once supported only by analyses of metaphorical language. Since the turn of the twenty-first century, however, experimental tests of metaphor theory have accumulated at an astonishing rate. There is now abundant evidence that people think metaphorically, across numerous conceptual domains, even when they are not using metaphorical language (for reviews, see Casasanto and Bottini 2014; Landau et al. 2010). For example: (1) when people experience physical warmth they feel "more warmly" toward their friends, expressing more emotional attachment to them (Ijzerman and Semin 2009; see also Citron and Goldberg 2014a; Williams and Bargh 2008). (2) When people see words presented closer together in space, they judge them to be "closer" in meaning (Casasanto 2008; see also Boot and Pecher 2010; Winter and Matlock 2013). (3) When people move objects upward they tend to retrieve more positive autobiographical memories (i.e., times when they were feeling "up" or "high on life"), and when they move objects downward they retrieve more negative memories (Casasanto and Dijkstra 2010; see also Brunyé et al. 2012; Crawford et al. 2006; Meier and Robinson 2004; Riskind 1983; Tracy and Matsumoto 2008). (Casasanto and Gijssels 2015, 327)

The discovery of mirror neurons has had a great impact on the empirical investigation of conceptual metaphors and on its theoretical implications. This chapter will accordingly be devoted to a critical overview of recent developments in CMT that have followed on the advancement in our understanding of the role of the mechanism of Embodied Simulation in the processing of figurative language.

Neuroscientific data on the mechanism of Embodied Simulation and its role in conceptual and linguistic processing, including figurative language, have determined a great deal of research on the neurally grounded nature of conceptual metaphors (e.g., Boulenger et al. 2012; Desai et al., 2011; Gallese and Sinigaglia, 2011; Glenberg and Kaschak, 2002; Kemmerer et al., 2008; Papeo et al., 2009). These data have opened new avenues for the study of metaphorical cognition. Importantly, this shift towards a radical neural foundation of CMT has not been understood as a change of paradigm by scholars actively involved in CMT but has been considered as a further logical development of the theory. Yet I will argue that the introduction of neuroscientific data into the conceptual metaphor debate has triggered a radical terminological and theoretical change from the conceptual to the neural level of description. This change has been so radical that I refer to it as the *embodied turn* in metaphor studies, after the cognitive turn of the eighties of the last century. However, as we are going to see, this theoretical and terminological shift, though pervasive, is not always consistent: the two levels, the conceptual and the neural, and the corresponding terminology, are often confused and used interchangeably.

Hence, in this chapter I will review some of the main positions in the current debate on CMT and its neural foundations to see how the discovery of the mechanism of Embodied Simulation has been received. I will also show how the new account of the mechanism of Embodied Simulation presented in Chapter 1 can solve some of the issues discussed in this debate. This will provide a new and original point of view on the role of embodiment in metaphor processing. The positions that will be reviewed and discussed here are far from exhausting the current debate but they are certainly representative of the most important lines of thinking.

2.2 From the Conceptual Metaphor Theory to the Neural Theory of Metaphor

Findings on mirror neurons and Embodied Simulation have given great momentum to research on the embodied nature of human cognition and in so doing they have also given a boost to the neural foundation of CMT. In this regard, it is worth noting that the embodied turn in metaphor studies was already in the air in the late eighties, even before mirror neurons were discovered. Significantly, in 1995, George Lakoff advanced what he defined as futuristic hypotheses about the functioning of the human mind. These hypotheses had to do with the embodied nature of cognition and the possibility that concepts could be directly represented in neural structures (see Regier 1992, PhD dissertation), without the need to have recourse to amodal symbols (e.g., Fodor, 1983), as had been customary until that time. In the years that followed, these hypotheses became central research aims in the work of many scholars in CMT and led directly to the taking of an important step in the development of CMT: the foundation of the Neural Theory of Language research group (henceforth NTL) at the University of California at Berkeley by Jerome Feldman, Professor of Computer Science, together with George Lakoff.

The research programme that this group set on the agenda was very ambitious: to understand how the brain computes thought and language on the basis of neuroscientific data and neural computation (Feldman and Narayanan, 2004). In a report on the main findings that NTL obtained in relation to metaphor studies, Lakoff (2008) describes the assumptions of this research programme as follows:

> We think with our brains. There is no other choice. Thought is physical. Ideas and the concepts that make them up are physically "computed" by brain structures. Reasoning is the activation of certain neuronal groups in the brain given prior activation of other neuronal groups. Everything we know, we know by virtue of our brains. Our physical brains make possible our concepts and ideas, everything we can possibly think is made possible and greatly limited by the nature of our brains. There is still a great deal to be learned about how the brain computes the mind. NTL combines what is known scientifically with linking hypotheses based on neural computation. (Lakoff 2008, 203)

There can be no doubt that this is a reductionist programme that aims to reduce the mind to the brain. This is suggested by Lakoff's recourse to the notion of computation. The fact that in this approach the brain can compute thoughts, ideas and concepts implies that thoughts, ideas and concepts can be entirely explained in neural terms, by means of neural computation.

Lakoff's reductionist claim about the mind is controversial. One of the best-known objections to the idea that the brain computes the mind has been offered in the "Chinese room" argument developed by philosopher John Searle (1980). Briefly, in this thought experiment, Searle imagines a scenario in which he is alone in a room with a batch of Chinese writings. He does not know a word of Chinese but he has been provided with rules, written in English, that allow him to correlate a set of Chinese symbols with another set of Chinese symbols. Hence, when someone from outside the room gives him a string of Chinese symbols he can reply with another string of Chinese symbols. In this way, although Searle does not understand Chinese at all, by following the rules he has been provided with, he can produce appropriate Chinese responses to the Chinese questions that someone outside the room is posing to him.

What Searle is doing here is applying syntactic rules to manipulate symbols. Computation is, indeed, the use of syntactic rules to manipulate strings of symbols. However, as this thought experiment suggests, information processing based on computation does not imply meaning or semantics. Similarly, if neural activity is computational, we cannot ascribe meanings and semantics to neurons. Mental contents cannot be merely computed by brains. In Searle's view (1980), while we can use computational models to simulate the mind, in a weak sense of simulation, we cannot say that the mind is computed by the brain. Instead minds and mental contents are properties that *emerge* from biological processes. These properties arise from biological entities and are inextricably tied to them, but cannot be simply reduced to them.

Despite these objections, the proposals developed in the NTL research programme do tend to reduce mind and language to neural computations. It is worth noting that reductionism usually aims at showing relationships between two different scientific disciplines, where knowledge and principles from the lower-level discipline, in this case neuroscience, are used to explain phenomena pertaining to the higher-level discipline, in this case thoughts, ideas and concepts (Nagel, 1949). In this sense, reductionism does not imply any attempt to deny the ontological reality of the reduced phenomena.

This is clearly expressed in the words of Steven Savitt (1974), who introduced the distinction between ontologically conservative (reductive) and ontologically radical (eliminative) theory change. In his view, reductionism implies ontologically conservative theory change, with entities of the replaced theory being relocated in the replacing theory. The example he provides is the theory of light. Earlier versions of the theory of light were gradually replaced by our current understanding of this phenomenon in terms of electromagnetic radiation. This change triggered a deep transformation of our conception of light. However, Savitt (1974) also pointed out that we have never denied that there is such a thing as light, although light is now identified with electromagnetic radiation. This means that the phenomena to be reduced keep their ontological reality while, at the same time, being entirely explained and identified with lower-level phenomena.

According to reductionist hypotheses about the mind/body or mind/brain problem, all the properties ascribed to the mind can in principle be explained and reduced to properties of the body/brain. As in the example of light we can explain all the properties of light in terms of electromagnetic radiation, just as we should be able to do when reducing the mind to the body/brain. Desire, intentions, beliefs, reasoning and so on should be identified with physical states of the body/brain. However, when applied to the mind/body problem, reductionist proposals are much more problematic than in the example of light. While we know exactly how to explain the properties of light in electromagnetic terms (we can find the principles of the theory of light in any handbook of physics), we do not yet have at our disposal any account of how to reduce beliefs, desires or other mental states to physical states of the body/brain. There is no handbook that explains the principles of the reduction of the mind to the body/brain. There is, thus, an explanatory gap (Levine, 1983) between the mind and the body/brain that we are far from bridging with our current knowledge of how the brain works. And clearly reductionist hypotheses are not compatible with other solutions for the mind/body problem such as emergentism (Searle, 1980).

Reductionism based on neural computation was not the main goal of the very first version of CMT (e.g. Lakoff and Johnson 1980). There is no discussion of the neural implementation of metaphorical thought in the first edition of *Metaphors* *we live by*. In 1980 the central aim of the founding fathers of CMT was to do the groundwork for the so-called cognitive turn in metaphor studies. But the giant steps forward taken by neurosciences in recent decades in our understanding of how the brain works and the concomitant significant developments in computer science and neural computation have made the project of the neural foundation of CMT much more concrete. This is explicitly acknowledged by Lakoff and Johnson themselves (1980, 254–255: second edition) in the 2003 afterword to the second edition of *Metaphors we live by*:

> A major advance in metaphor theory came in 1997 with fundamental insights by Joseph Grady (1997b), Christopher Johnson (1997), and Srinivas Narayanan (1997). […]. Using computational techniques for neural modelling, Narayanan developed a theory in which conceptual metaphors are computed neurally via neural maps–neural circuitry linking the sensory-motor system with higher cortical areas. (Lakoff and Johnson 1980, second edition, 254–255)

This evolution towards a neural foundation for CMT needs to be contextualized against the wider philosophical and neuroscientific background concerned with the relation between brain, mind and body, a theme also discussed at length by Lakoff (1987) and Johnson (1987). Although today we know a lot about the brain, we do not know enough to develop a complete explanation of the mind based on how the brain functions, even if this is the explicit goal of many scholars working in the NTL research programmes (e.g., Feldman 2006, xiv; Lakoff and Johnson, 1980: second edition; Narayanan, 1997). However, at the same time, a dualistic position, i.e., the idea that the mind and the brain/body are distinct entities that cannot be assimilated to each other, clearly cannot today resist the weight of the counterarguments and of the empirical evidence that have been provided against it (see Johnson, 2017). On the basis of our current knowledge in cognitive neuroscience, for example, philosophical theses based on the idea of "multiple realizability" could probably not be defended any more. Multiple realizability was one of the recurrent and central arguments of Functionalism and of the Computational and Representational Theory of Mind (henceforth CRTM; see Putnam 1960; Fodor 1983). The basic idea of multiple realizability was that one and the same psychological states can be implemented in many different types of physical entities, even in entities physically very different from one another. Hence, in a functionalist account, it follows that if we want to understand how the mind works we can only describe the cause-and-effect relationships that link psychological states. The description of the physical entities, i.e., the brains or other kinds of entity, in which these states are implemented, does not really matter, because their physical characteristics will not make any difference at the psychological level (Putnam, 1960). The argument of multiple realizability was clearly used to support non-reductionist accounts of the mind–body problem. Today, however, criticisms of the multiple realizability argument have flourished (e.g., Bechtel and Mundale, 1999) and there are plenty of accounts that show how the mind is shaped by the body (e.g. Johnson, 2017; Noë, 2004; Hutto and Myin, 2017; Clark, 2016a, 2016b, 2016c).

At the same time, it is important to highlight that in many of the recent embodied accounts of mind and language, the body has been basically equated to the brain. In these approaches, there is little place for a non-neural acceptation of the notion of body. Barsalou (1999), as we saw in the previous chapter, is one of the most authoritative scholars to have developed neurocentric accounts of the mind. In his view (Barsalou 1999, 582), perceptual symbols, the building blocks of cognition, "are neural representations in sensory-motor areas of the brain". His view has had a great influence on a huge number of researchers and has been referred to in thousands of publications (see Casasanto and Gijssels, 2015). And his approach to the embodiment of mind and language has also significantly influenced the research carried out in the NTL programme.

The NTL and the related Neural Theory of Metaphor (henceforth NTM) are beyond any doubt neuro-centric accounts of language and metaphor. Meaning, in this research paradigm, has been described in terms of mental simulation, where mental simulation stands for the mechanism of Embodied Simulation in its merely neural connotation (i.e., ESN). This conclusion is explicitly suggested in many of the later writings of Lakoff (e.g., Gallese and Lakoff, 2005) and it is also stated in his 2008 report on the state of the art in NTM:

> Simulation semantics is based on a simple observation of Feldman's: if you cannot imagine someone picking up a glass, you can't understand the meaning of "Someone picked up a glass." Feldman argues that, for meanings of physical concepts, meaning is mental simulation – that is, the activation of the neurons needed to imagine perceiving or performing an action. Thus, all mental simulation is embodied, since it uses the same neural substrate used for action, perception, emotion, etc. (Lakoff 2008, 204)

The problem with this account is that meaning is considered to be a property that we can ascribe to neurons ("for meanings of physical concepts, meaning is mental simulation – that is, the activation of the neurons needed to imagine perceiving or performing an action"). As we saw in the first chapter of this book, it is not theoretically plausible to ascribe content and, hence, meaning, to neurons. Meaning is a property that pertains to a different level of description.

Be this as it may, neuroscientific discoveries in recent decades have still given this great momentum to the neural grounding of theories of meaning and metaphor. After the discovery of the mechanism of simulation, findings were reported that mental imagery, language processing, and even the processing of metaphors, and action execution all share the same neural substrates (Gallese and Lakoff 2005, 456). This provided compelling arguments for the development of a neural theory of metaphor.

Many empirical findings have indeed shown that the processing of metaphors recruits the mechanism of simulation. The comprehension of metaphorical usages of the verb "grasp", for example, in expressions such as "to grasp an idea", triggers the activation of the neural circuits related to the experience of grasping (Gallese and Lakoff, 2005), even if we are not currently physically grasping anything (see Chapter 1). These neural circuits, which are the source domain of the metaphor, will map onto the neural circuits related to our concept of "understanding", the target domain of the metaphor. The "grasping" motor circuit, in other words, will fire every time we process the abstract concept "understanding" and will, thus, ground its meaning in our sensorimotor system.

The frequent simultaneous activation of the neural circuits related to source and target domains, following Hebbian principles (Hebb, 1949), will lead them to wire together in a more complex and integrated neural circuit. Metaphorical mappings, in this description, are thus physical neural circuits that link integrated neural circuits together (Lakoff 2008, 215). This metaphorical foundation of abstract concepts has been observed in behavioural, neuroimaging and neurophysiology studies which, using different experimental techniques, have all shown the somatotopic[1] activation of the sensorimotor system during the processing of abstract concepts. These findings have been understood as providing evidence for the neural grounding of conceptual metaphors (for a review and critical discussion, see Borghi et al., 2017).

It is worth noting that, according to the NTM, concepts and metaphors are embodied in the brain, not just because they are physically computed by the brain (everything we do is related to activation in the brain) but because they are grounded in the sensorimotor system to the extent that even the inferences that these concepts produce can be described as inferential chains taking place in the sensorimotor system. This is one of the main tenets of the embodied turn in metaphor studies and it was clearly stated in Lakoff and Johnson (1999, 29).

> All of these conceptual structures are, of course, neural structures in our brains. This makes them embodied in the trivial sense that any mental construct is realized neurally. But there is a deeper and more important sense in which our concepts are embodied. What makes concepts concepts is their inferential capacity, their ability to be bound together in ways that yield inferences. An embodied

1. The expression "somatotopic organization" of the central nervous system is used by neuroscientists to refer to the point-to-point correspondence between parts of the body and parts of the brain that are activated by them.

> concept is a neural structure that is actually part of, or makes use of the sensorimotor system of our brains. Much of conceptual inference is, therefore, sensorimotor inference. (Lakoff and Johnson 1999, 29)

Scholars working in the NTL do not deny the existence of a conceptual level (to be more precise, they explicitly claim that there are three different levels of embodiment: the neural level, the phenomenological level and the conceptual/cognitive level; see Lakoff and Johnson 1999; see also Gibbs 2006b for a discussion); however, as this passage makes clear, the properties ascribed to the conceptual level are directly ascribed to neurons. And the neural level is the focus of their attention. This is perfectly in line with the reductionist tendency of this research paradigm.

Following this principle, concepts are identified in the NTM with the activation of neurons in the brain. I must admit, in this regard, that in recent decades we have come very far in our understanding of how the brain works. However, we still have a long way to go, as Lakoff himself has acknowledged (Lakoff 2008, 203). The reduction from concepts to neurons, should it ever be possible, will not be an easy task, for many reasons. I will not summarize here all the issues currently discussed in this debate and all the problematic aspects that make this reduction really difficult to achieve fully (e.g. Levine, 1983). I will, instead, highlight one problematic aspect that seems to be particularly relevant, especially in relation to the new account of Embodied Simulation, both in the narrow and in the broad sense, proposed in the first chapter of this book. In the words of Antonio Damasio (1994) this issue can be summarized as follows:

> The mind is embodied, in the full sense of the term, not just "embrained"; mainstream cognitive psychology, cognitive neuroscience and philosophy of mind, by contrast, mainly characterizes embodiment as "embrainment". (Damasio 1994, 118)

Scholars working in the NTM certainly do the same, focusing only on the brain and not leaving room for the rest of the body (e.g., Feldman, 2006).

The body plays an important role in cognition (Gallagher 2005, 136). Influential researchers such as Merleau-Ponty (1945), Piaget (1971), Neisser (1987), Varela, Thompson and Rosch (1991), Clark (1997) and Noë (2004) have all provided arguments in support of the thesis that cognition depends on our experiences and that those experiences, in turn, depend on our perceptual and motor capacities. Our cognitive functions, among them language, are certainly affected and determined by the architecture and dynamics of the human brain. However, it is the body in its full complexity that shapes our cognitive functions, not only the brain. The way we perceive the world is determined not just by the brain that we have but also by the physical structure of the rest of our body and by the motor repertoire that this physical body allows us to perform (see Noë, 2004 for a discussion).

This topic is also discussed by some of the authors in CMT. Mark Johnson, for instance, is perfectly aware of the danger of "embrainment" and he warns us against it. Talking about the notion of an image schema as a central notion in defining the embodied nature of meaning, Johnson clearly claims that we cannot define it as something taking place only at the neural level. This kind of description is certainly not enough:

> In speaking of image schemas as invariant topological structures in various perceptual and motor maps, however, we must not think of image schemas as existing merely in the brain apart from the bodily perceptions, feelings, and actions in which that brain plays a central role. We must always remember that image schemas exist only for organisms that have certain kinds of brain architecture, operating within bodies of a particular physiological makeup, interacting with environments that offer very specific "affordances" (Gibson 1979) for creatures like us. (Johnson 2005, 19)

Clearly, Johnson's position about neuro-centric accounts of mind and language such as NTL is cautious. Although he acknowledges that there is growing evidence that language understanding recruits Embodied Simulation, he clearly suggests that "it is too early to make any sweeping claims about the scope and adequacy" of this proposal (Johnson 2017, 25). From this point of view, NTM, being beyond any doubt a neuro-centric version of embodiment, can only give us a partial understanding of the role that the body plays in language and cognition.

A glimpse at the projects carried out in the NTM research group demonstrates the partial nature of that research (e.g., Bailey, 1998; Narayanan 1997; Regier, 1996). Those projects, relying on computer science and neural computation, developed models of how the human brain, a physical aggregate of neurons, can give rise to concepts and language. Regier (1996), for example, developed a neural model for learning spatial terms, in both concrete and abstract usage. In that model, he used topographical maps of the visual field to compute image schemas, orientation-sensitive cell assemblies to compute orientational aspects of spatial concepts and centre-sensitive receptor fields to compute other kinds of concepts. Analogously, Narayanan (1997) developed a neural model for metaphors in economics. In his model, embodied metaphors, mainly grounded in the domain of motion, and all the inferences that can be drawn from them, are computed by means of simulations of neural structures for motor control.

However, these models will always and inevitably be only a partial and incomplete description of what they want to explain. This is because they identify the conceptual with the neural level but lack any explanation of how to operate this reduction. As we saw a few pages back, we do not have any handbook that illustrates how the mind can be explained in terms of neural activity such as the handbooks showing how light can be fully explained in terms of electromagnetic radiation. Hence, if we confine our research on mind and language to the neural level, we will inevitably miss the point of what we want to explain.

Searle's Chinese room argument, among others (see also Hutto and Myin 2017), has provided theoretically compelling reasons in support of this objection. Neural models seek to explain the behaviour of a complex system, such as the human mind, by identifying that system with one of its parts – a part that cannot be considered to represent the system in all its complexity. And they do so without providing the principles of this reduction. This is true even though Lakoff and Johnson, in the introduction to their 1999 volume, explicitly refer to Merleau-Ponty as a precursor of their own embodied approach to the mind. If embodiment means "embrainment", as seems to be the case in the NTM, then Merleau-Ponty, one of the philosophers who focused more on the role of a not merely neural body in human cognition, cannot be considered a direct predecessor of this approach. And if embodiment means "embrainment" much of the role played by the body in human cognition cannot be accounted for in this approach.

In discussing the embodied, or embrained, grounding of conceptual metaphors I cannot avoid making a quick reference here to Primary Metaphors, which have been defined by Grady and collaborators (e.g. Grady 1997a, 1997b, 2005; Grady and Johnson 1997; Grady and Ascoli, 2017) as experiential correlations (this topic will be discussed in greater detail in Chapter 3):

> CMT has assumed that the link between the concepts paired in a primary metaphor is rooted in highly regular correlations in experience, such as those between the weight of an object and our ease or difficulty in handling it in the case of DIFFICULT IS HEAVY. (Grady and Ascoli 2017, 28)

Primary Metaphors are those metaphors in which a mapping is established between conceptual representations of experiences that often co-occur in our everyday life. The source domain of a primary metaphor is a concept that refers to a basic sensory experience that usually turns up together with a non-sensory experience. Primary Metaphor Theory (henceforth PMT) has had a tremendous impact on the field of metaphor studies and continues to be very influential. Lakoff (2008, 216) explicitly regards Grady as one of the scholars who, at the very beginning of the NTM, greatly contributed to giving momentum to the development of the research programme. In Lakoff's own words (2008, 216), "The neural theory of metaphor got its real impetus from three Berkeley dissertations done in 1997 – by Srini Narayanan, Joe Grady, and Christopher Johnson".

Grady's work aims at explaining the role of experiences in structuring our language and hence at describing the bodily foundation of metaphorical cognition (see Chapter 3). A central question in PMT, thus, concerns the way we parse our experiences and how those experiences can influence and motivate features of language. Research on this topic had already been carried out by others before Grady. Notions such as that of *experiential domains* (Lakoff and Johnson, 1980), *prototypical events* (Slobin, 1985) or *case frames and semantic frames* (Fillmore, 1968, 1982) are examples of accounts proposed to explain how we identify and determine units in our experiences and how these play a role in language (see Grady and Johnson 1997, 123 for a discussion).

Conceptual representations of experiential units thus constitute the source and the target domains of primary metaphors. Following Grady (2005), it is possible to consider the source concept of a primary metaphor to be equivalent to an image schema. Image schemas may, then, be tied directly to the neural level. For this reason, PMT has contributed according to Lakoff (2008) to the development of NTL:

> It may even be possible at some later date to tie individual image schemas to elements of human cognitive and neural "programming" relating to perception of the physical world – a possibility suggested in Turner (1991, 182) and elsewhere. (Grady 2005, 1605–1606)

The neural level, as Grady suggests, is a potential next step in our investigation of conceptual metaphors and it seems to be the logical next step in the development of PMT. In fact, in recent works (e.g. Grady and Ascoli, 2017), Grady seems to go exactly in this direction, advancing a proposal on the neural character of Primary Source and Target.

It is also worth noting that the notion of image schema, in Grady's interpretation, seems to directly tie the conceptual level to the level of the brain. However, as anticipated at the beginning of this chapter, in the current debate in CMT there is a theoretical and terminological overlap between the conceptual and the neural levels of analysis. The notion of image schema is certainly one of the most critical concepts from this point of view. This notion was independently introduced by Lakoff and Johnson (Lakoff 1987; Johnson 1987) at the end of the eighties of the last century. Image schemas were conceived of as the bodily bases on which our conceptual system is built. However, although this notion was presented as one of the pillars of CMT, it has been one of the most controversial notions in cognitive linguistics. The controversies concern, at least, the following issues: the definition of image schemas, their universal or culturally determined nature, and the identification of a set of criteria for their recognition. These problematic aspects are strictly interconnected with one another and consequential upon one another. When we have a clear and unambiguous definition of the notion of image schema it will follow that the controversy about their supposed universal or culturally determined nature will be clarified and a set of criteria for their identification will be defined.

Hampe (2005, 1–2)'s cross-reading of Lakoff's and Johnson's 1987 monographs for definitional criteria of the original notion has resulted in the following summary:

- Image schemas are directly meaningful ("experiential"/ "embodied"), preconceptual structures, which arise from, or are grounded in, human recurrent bodily movements through space, perceptual interactions, and ways of manipulating objects.
- Image schemas are highly schematic gestalts which capture the structural contours of sensory-motor experience, integrating information from multiple modalities.
- Image schemas exist as continuous and analogue patterns beneath conscious awareness, prior to and independently of other concepts.
- As gestalts, image schemas are both internally structured, i.e., made up of very few related parts, and highly flexible. This flexibility becomes manifest in the numerous transformations they undergo in various experiential contexts, all of which are closely related to perceptual (gestalt) principles (Hampe 2005, 1–2).

These definitions suggest that image schemas are highly schematic, preconceptual, and unconscious, structures that are grounded in our bodily movements. However, although image schemas were not defined by Lakoff and Johnson as explicit and conscious mental representations, many cognitive linguists, as Gibbs has noticed (2005, 115), have interpreted them precisely as explicit mental representations stored in our long-term memory (for a further discussion of this topic see Gibbs 2005).

Mark Johnson (2005) has more recently offered another definition of image schemas. In this account, image schemas are defined as follows:

> Patterns characterizing invariant structures within topological neural maps for various sensory and motor areas in the brain [...]. In speaking of image schemas as invariant topological structures in various perceptual and motor maps, however, we must not think of image schemas as existing merely in the brain apart from the bodily perceptions, feelings and actions in which that brain plays a central role. (Johnson 2005, 19)

Johnson seems to be perfectly aware that a strict neuro-centric account of the role of the body in conceptual metaphors is not theoretically plausible. This consideration prompts me to provide some concluding remarks for this section.

As we have seen, the discovery of mirror neurons and of the mechanism of Embodied Simulation triggered a significant shift in CMT towards a neural grounding of conceptual metaphors. Specific research programmes such as the NTL and the NTM were developed for this purpose. However, all the proposals in the NTL and NTM research paradigm inevitably face the problem of the naturalization of content. They regard meaning as a property that can be ascribed to neurons. But, as I argued in the first chapter of this book, the properties of meaning and content do not pertain to neurons. In the next section of this chapter I will analyse how the discovery of the mechanism of Embodied Simulation has been received by other scholars in CMT that are not committed to a drastic neural shift.

2.3 From the Neural Theory of Metaphor to the Conceptual Metaphor Theory

Even though the NTM has gained momentum in recent years and has been supported, both with theoretical and empirical work, by influential scholars, CMT without commitments to neural reductionism still seems to be an influential option on the market (but it is worth noting that it does not directly contradict the principles of the NTM). Many researchers are not involved or even interested in the development of models for neural computation of conceptual metaphors and they keep doing metaphor research mainly in the form of analysis carried out at the conceptual and linguistic levels. However, the embodied turn, due to the discovery of mirror neurons and to the mechanism of Embodied Simulation, has inevitably influenced their work as well, albeit in different ways. How have neuroscientific findings on metaphor processing been received by some of the scholars that work in the paradigm of CMT in its non-neurocentric version?

I will start this brief and inexhaustive overview by considering the "phenomenological" approach to simulation that is mainly associated with the work of Raymond Gibbs (e.g. 2006a, 2006b). In Gibbs's terms, metaphor interpretation is Embodied Simulation. However, in contrast to claims made in the NTM project, this assumption does not amount to a reductionist position because Embodied Simulation is not defined as a pattern of neural activation but, instead, as a complex process in which both mental acts and bodily experiences, on the one hand, and subpersonal processes, on the other, are intimately involved (Gibbs 2006a, 442):

> Finally, my thesis that many kinds of metaphors are understood through embodied simulations adopts a wide view of embodiment. Critical brain areas (e.g. motor cortex) are likely recruited during ordinary linguistic processing of both metaphorical and nonmetaphorical language. But as importantly, people's intuitive, felt, phenomenological experiences of their own bodies shape large portions of metaphoric thought and language use. (Gibbs 2006a, 436)

From this passage we can infer some of the peculiarities of Gibbs's ideas about embodiment and metaphor processing. While he is proposing a broad understanding of embodiment and not a form of "embrainment", and thus has very different theoretical goals from NTM, it is also immediately evident that his position is quite different from the versions of CMT that were circulating before the dawn of neural computation in metaphor studies. Classic versions of CMT described metaphor processing as a cognitive and disembodied process in which we access and connect, through metaphorical mappings, abstract and amodal domains of knowledge. In other words, as Gibbs suggests in his 2006a paper on "Metaphor Interpretation as Embodied Simulation", although in CMT conceptual metaphors have an experiential basis, the process of accessing metaphorically structured knowledge does not directly involve our bodily experiences at the phenomenological level:

> Cognitive linguists have mostly characterized the activation of conceptual metaphor during metaphor understanding as a purely cognitive process. Thus, understanding the conventional phrase 'Our relationship has hit a dead-end street' is partly accomplished through the activation of the conceptual metaphor LIFE IS A JOURNEY in long-term memory. This enduring chunk of metaphorical knowledge has a source domain (e.g. JOURNEY) that is grounded in the pervasive bodily experience, or image-schema, of SOURCE-PATH-GOAL. But the entire process of accessing a specific conceptual metaphor during verbal metaphor understanding is mostly viewed as activating abstract, schematic, disembodied knowledge that is not tied to ongoing bodily action. (Gibbs 2006a, 441)

Thus, according to Gibbs's reading of CMT, the processing of conceptual metaphors is a disembodied cognitive operation. This interpretation is largely embraceable and, as seen before, can be taken further. The role of the body in neuro-centric accounts of CMT is reduced to neural representations that can be computationally manipulated in a kind of revised version of the CRTM (see Bailey, 1998; Narayanan 1997; Regier, 1996 projects). In Gibbs's approach, by contrast, our felt sensations have a role in metaphor interpretation to the extent that these sensations shape our metaphorical thought. Importantly, following Gibbs, these sensations are elicited by mental imagination.

This last claim is a starting point for sketching some of the differences between Gibbs's approach and the proposal advanced here. The first thing to note is that when Gibbs defines Embodied Simulation he does not directly or exclusively refer to the neural mechanism described in the first chapter of this book. He refers to a mental act or operation, explicitly identified with imagination, and also connected, but not reduced, to the neural, or subpersonal, mechanism of simulation:

> Making the case for embodied metaphor is the first step toward establishing my claim that many verbal metaphors are specifically interpreted in terms of embodied simulations. Simply put, one reason why people interpret many verbal metaphors through embodied simulations is because this metaphoric language

> is rooted in bodily processes that people may imaginatively recreate during their ordinary use of such language. (Gibbs 2006a, 436)

Thus, Embodied Simulation, in Gibbs's terms, is first and foremost a high-level process because it begins with a mental, imaginative, act ("this metaphoric language is rooted in bodily processes that people may *imaginatively recreate*") and, then, presumably in a top-down relationship, it also involves the full body, with phenomenologically felt experiences, and the mechanism of simulation at the brain level:

> […] imaginative simulations are mental actions where one is not doing one thing to stand for another, but where one mentally engages in actions similar to those overtly referred to. For instance, when I imagine what it feels like to kick a ball, I do not engage in some other action, such as kicking a rock to do so. Instead, I mentally construct a scenario of my own body kicking a ball. This simulation is not abstract, in the way, for example, that a computer simulation of a hurricane mimics abstract elements of how a hurricane moves. Embodied simulations have a full-bodied feel to them, in the way that a person may experience actual sensations of movement when flying an aircraft simulator. (Gibbs 2006a, 442)

Imagination, in this account, does not need to be conscious but still is a process that takes place primarily at the level of thought. Following Gibbs (2006a, 442), imaginative Embodied Simulation is intimately involved with subpersonal processes. But the nature of this intimate involvement between imagination and the subpersonal, neural level of simulation is not explained any further. In other words, the cognitive contribution of the mechanism of Embodied Simulation in the narrow sense (ESN) remains unclear in this account. There seems to be an explanatory gap between the activation of this mechanism and its cognitive contribution.

By contrast, in the account developed here this gap is bridged because, as was argued in Chapter 1, ESN is the starting point of a bottom-up process that can be fully explained and in which the neural simulation can lead to felt sensations, i.e. to ESB. These sensations are, then, directly involved in metaphor interpretation, being already a personal-level experience.

The differences between Gibbs's account and the present proposal become more evident if we look at his discussion of the neural mechanism of simulation in the context of imaginative Embodied Simulation. Gibbs clearly acknowledges the involvement of this mechanism in imagination and in many other cognitive tasks and he summarizes many empirical data supporting this claim. To give an example, he briefly reviews empirical work suggesting that the motor system is activated during cognitive tasks such as mental imagery, action understanding, imitation, and empathy (Gibbs 2006a, 443). The conclusion he draws from these data is that all these cognitive tasks make use of the same motor activities *as motor representations*:

> Observations like this have been extensively reported in human studies showing that there are shared motor representations for action, observation of another person's actions, and imitation and mental simulation of action (Decety and Grezes, 1999).
>
> (Gibbs 2006a, 443; see also Gibbs and Pelosi Silva de Macedo 2010, 682)

This conclusion leads us back to a representational account of the neural mechanism of simulation that was rejected as not theoretically coherent or explanatorily useful in the first chapter of this book.

Gibbs's position on the topic of embodiment and conceptual metaphor seems to be rather unique. He considers the discovery of mirror neurons and the hypothesis of language understanding as Embodied Simulation to be vital for the interpretation of embodied metaphors. However, he proposes an account of embodiment that is not neuro-centric, and thus it differs from NTM. It also takes into account the role of the phenomenological body during metaphor interpretation and therefore also differs from classic accounts of CMT, which generally do not consider the role of the physical body in the process of accessing conceptual knowledge. But his proposal seems to lack any explanatory link between the subpersonal and personal levels of Embodied Simulation.

We now need to see how the discovery of mirror neurons and the hypothesis of language understanding as Embodied Simulation have been received by scholars embracing a more traditional, non-neurocentric version of CMT. In recent years, research on conceptual metaphors has increased significantly, with scholars actively applying the principles of CMT and finding evidence for it in many different new domains of experience and even in previously unexplored modalities of expression. As Fusaroli and Morgagni have highlighted (2013, 3), conceptual metaphors, in the last thirty years, have been analysed in domains such as mathematics (Lakoff and Núñez, 2000), political discourse (Lakoff, 2002, 2006), expression of pain (Semino, 2010), literature (Lakoff and Turner, 1989), pictorial representations and comics (Eerden, 2009; Forceville, 1998, 2005, 2006; Refaie, 2003; Rothenberg, 2008; Shinohara and Matsunaka, 2009), videos (Fahlenbrach, 2005, 2007) and in sign languages (Taub, 2001; Wilcox, 1993). Clearly, CMT has significantly expanded its field of application and these developments can be regarded as a different and completely independent line of research from NTM. Many of the scholars applying conceptual metaphor analysis to new domains and forms of expression are not interested in the issue of the neural foundation of metaphors. This topic is not directly addressed in many of their works. They usually carry out research based on detailed analyses of the conceptual level and of the level of expression (linguistic, visual, etc.).

In its early formulations and in its recent developments, CMT has always been a proposal supporting the embodied nature of human cognition. However, the notion of embodiment has different meanings. More specifically, embodiment has at least two meanings, not contrasting but complementary to each other, as we will see more fully in Chapter 3. The understanding of embodiment depends on the level we choose to analyse to explore the role that the body plays in cognition. This role may be direct (an example is the role of sensorimotor contingencies in shaping perception) or can be mediated by a conceptual representation (for example, all our conceptual representations related to the body and to our bodily experiences, ranging from basic experiences to more complex ones). This difference comes down to two different levels of embodiment.

As will be argued in the next chapter, it is here proposed that classic CMT defends a form of embodiment at the conceptual level: our conceptual system, or at least part of it, is structured by conceptual representations of our body and of the experiences that this body allows us to have. At this level, conceptual representations of the body contribute, by means of metaphorical mappings, to the structuring of other concepts. This metaphorical structure of thought has been reconstructed by means of linguistic analyses because it has been hypothesized that metaphorical thought manifests itself in language (as well as in other forms of expression). LIFE IS A JOURNEY or LOVE IS A JOURNEY are classic examples of conceptual metaphors through which we conceptualize an abstract concept (LIFE or LOVE) in terms of a physical experience (a JOURNEY) and whose corresponding linguistic expressions have been analysed in different languages from all over the world.

Hence, classic CMT, although it does not conflict with NTM, is not necessarily committed to involving itself directly in studies of the neural grounding of conceptual metaphors. However, a further distinction is needed among scholars working in CMT but not directly involved in the NTM. In fact, while, as argued, in some of the most recent developments of CMT (see Fusaroli and Morgagni, 2013 for a review) the issue of the neural foundation of metaphors has not been directly addressed or regarded as a central topic (e.g., Eerden, 2009; Fahlenbrach, 2005, 2007; Forceville, 1998, 2005, 2006; Refaie, 2003; Rothenberg, 2008; Shinohara and Matsunaka, 2009; Taub, 2001; Wilcox, 1993), many other scholars currently working in the paradigm of conceptual metaphors, although themselves not directly involved in neuroscientific research or in projects on neural computation, acknowledge the importance of the discovery of mirror neurons and of the mechanism of Embodied Simulation and emphasize the relation between conceptual and linguistic analyses and the research on the neural level being carried out by neuroscientists and computer scientists (Lakoff and Núñez, 2000; Ritchie, 2008; Semino, 2010). The latter kind of research is regarded as grounding the former, and conceptual metaphors are thought of as being implemented in modality-specific areas of the brain. Some of these scholars, although not necessarily involved in neuroscientific or computer science research, have conducted behavioural experiments aimed at showing the involvement of the sensory and motor systems in metaphor processing (e.g. Dudschig et al., 2014). In the last thirty years, behavioural studies have shown that, while we process bodily-based conceptual metaphors, our sensory and motor systems are activated accordingly. The metaphor GOOD IS UP, to give one example, has been empirically investigated by many behavioural researchers (Brookshire et al., 2010; Bruyé et al., 2012; Dudschig et al., 2014; Meier and Robinson, 2004; Santana and de Vega, 2011;) and the same is true for many other primary metaphors (e.g. POWER IS HEIGHT: Schubert, 2005; IMPORTANCE IS WEIGHT: Jostmann et al., 2009; TIME IS MOTION: Miles et al., 2010; EVIL IS DARKNESS: Sherman and Clore, 2009: SUSPICION IS FISHY-SMELLING: Lee and Schwarz, 2012).

The conclusions drawn from these studies converge on the idea that conceptual metaphors can be directly identified with patterns of neural activation in the brain, as suggested by Lakoff (2008, 2014) and Feldman (2006). This means that, in the works of these authors, too, conceptual metaphors are conceived of as being implemented in modality-specific areas of the brain and thus directly identified with patterns of neural activation (see Lakoff 2014 for a review).

There is a strong fundamental motivation why this reductionist approach is advocated by many scholars of CMT. From its very beginnings, CMT presented itself as an embodied account of human cognition and thus as a radical alternative to research programmes such as CRTM. The CRTM has been very influential in philosophy, psychology, cognitive science and linguistics (e.g., Fodor, 1983; Fodor and Pylyshyn 1988; Gallistel and King 2009). This research paradigm describes human cognition in terms of computations on amodal abstract symbols. The concepts on which cognitive operations are carried out and which constitute our conceptual system in this approach are not tied to modalities of perception or to any form of bodily experience. They are entirely abstract and symbolic (e.g., Fodor, 1983; Fodor and Pylyshyn 1988; Gallistel and King 2009).

By contrast, CMT proposes a view of cognition that is deeply grounded in our everyday bodily experiences (Lakoff and Johnson, 1980). As a consequence, the neural grounding of human metaphorical thought through the mechanism of Embodied Simulation is regarded as a strong argument in support of the embodied approach to cognition and against any disembodied, functionalist, view of the human mind. In this perspective, the activation of the neural circuit of "grasping" in the premotor cortex during the processing of literal and metaphorical uses of this verb (e.g. "to grasp a glass" and "to grasp an idea"; see Boulanger et al., 2009) is considered to be evidence that both the concrete concept of physical "grasping" and the abstract concept of "understanding" are implemented in the same modality-specific area of the brain. Both concepts are thus comprehended by means of our knowledge of the physical act of grasping because both the concrete and the abstract concept recruit the same neural substrates of the physical action of grasping (Gallese and Lakoff, 2005).

Neuroscientific findings on the mechanism of Embodied Simulation show that bodily knowledge is an integral part of the process of language comprehension and readily support the claim that cognition is embodied. However, in this approach, the cognitive contribution of the mechanism of Embodied Simulation is not problematized and is usually not further discussed. This means that the explanatory gap between the neural level on the one hand and the level of cognition and personal experiences on the other is not bridged. The role of Embodied Simulation is generally explained by having recourse to the representational account proposed by Barsalou (1999). However, as already argued, the proposal advanced in this book does aim to bridge the gap and hence to explain the cognitive role of Embodied Simulation.

To conclude this certainly not exhaustive review, I need to acknowledge another option in the framework of classic CMT that is currently available in the debate. In the line of research that can be traced back to this option, the behavioural and neuroscientific findings that CMT has relied on for over thirty years to support the embodied nature of metaphors are not considered to be truly reliable. This line of research is led by Daniel Casasanto and his collaborators. Casasanto and Gijssels (2015), for example, have reviewed many behavioural and neuroscientific studies with the aim of showing that conceptual metaphor processing does not necessarily involve activation of the mechanism of Embodied Simulation. In their opinion, the findings reviewed either do not provide evidence for the embodied nature of conceptual metaphors or provide data that can be easily interpreted in alternative ways.

Specifically, they report that they are aware of only one neuroimaging experiment that directly investigates the potential embodied nature of conceptual metaphors (Quadflieg et al., 2011). Using the fMRI technique, the authors of that study examined whether the spatial source domain (UP-DOWN) of conceptual metaphors like GOOD IS UP or POWERFUL IS UP was activated and implemented in modality-specific areas of the brain during the processing of words meaning power or powerlessness (e.g., boss, intern) or with positive or negative valence (e.g., beauty, tragedy), where the GOOD IS UP and the POWERFUL IS UP conceptual metaphors respectively should be involved. Experimental data in Quadflieg and colleagues' study (2011) did not show the activation of modality-specific brain areas during the processing of those words. In addition, findings from their work suggested that the representations of spatial source domains in these conceptual metaphors were implemented in modality-non specific brain areas. This aspect is particularly interesting with regard to the account of the mechanism of simulation proposed here and to its possible application to different kinds of metaphors. As we will see in detail in Chapters 4 and 5, I claim that Embodied Simulation, both in the narrow and the broad sense, is not always recruited, or not always to the same extent, during metaphor processing.

As for the many behavioural studies carried out to test the involvement of the sensory and motor systems in conceptual metaphor processing, Casasanto and Gijssels (2015) argue that these findings could be interpreted without resorting to the mechanism of simulation and could make sense even if what we currently know about the mechanism of simulation, at some point, were proved to be false. In other words, following Casasanto and Gijssels's (2015) argument, CMT is true even without evidence of modality-specific simulations occurring during the processing of conceptual metaphors. First because, theoretically speaking, CMT does not need this kind of empirical support (in a fully conceptual account of CMT, the metaphorical structure of concepts can be considered to be independent of its neural implementation) and second because the data we currently have cannot be unambiguously interpreted as evidence in favour of the hypothesis that conceptual metaphors are necessarily implemented in modality-specific areas of the brain:

> There is strong evidence that people think in mental metaphors, and strong evidence that some of our thinking is embodied. But there is very little evidence that mental metaphors are embodied in modality-specific simulations. On the contrary, there is evidence that some mental metaphors are not embodied in this sense. There is, therefore, a Grand Canyon-sized gap between the strength of many researchers' belief in "embodied metaphors" and the strength of the evidence on which their beliefs should be based. (Casasanto and Gijssels 2015)

The difference between Casasanto and Gijssels's approach to the topic of metaphor and embodiment and the proposal advanced here is easily accounted for. Casasanto and Gijssels are working exclusively on embodiment at the conceptual level. Representations of the body, which could easily be amodal, as they acknowledge, shape our conceptual system. In their account the body thus contributes to cognition being the object of a conceptual representation. There is no room for the phenomenological body in their approach. The metaphorical mappings they analyse and are interested in all take place at the conceptual level and have conceptual representations of the body as their source domain. What is more, conceptual metaphors, in their view, involve representations of the body implemented in amodal areas of the brain. As a consequence, according to Casasanto and Gijssels, we do not need to look for modality-specific activations in the brain during the processing of conceptual metaphors.

As we have seen, divergent positions can be observed among scholars who are not directly involved in research programmes on the neural foundation of language and conceptual metaphors. These different positions reflect how the discovery of the mechanism of simulation has been differentially received in their work. All in all, it can be claimed that the majority of researchers in metaphor studies, with few exceptions to this rule such as Casasanto and Gijssels, seem to accept more or less explicitly or, at least, seem to not directly object to the role of Embodied Simulation in the processing of conceptual metaphors. In their account, Embodied Simulation is mainly described in representational terms.

2.4 Conclusion

To summarize the discussion carried out in this chapter, we can say that CMT, after the neuroscientific discovery of mirror neurons and Embodied Simulation, has developed at least two different research programmes. The first has a distinctive strong vocation for the study of the neural grounding of conceptual metaphors. The methodologies adopted in this research programme involve computer science and neural computation. The role of the body, in this tradition, seems to be reduced to the role of the brain. This approach is clearly definable as neuro-centric.

The other research programme is not committed to the direct investigation of the neural level of metaphors. But the scholars working in this research paradigm, with few exceptions (e.g., Casasanto and Gijssels, 2015) do acknowledge the role of the mechanism of simulation in conceptual metaphor processing. Embodied Simulation is usually defined with reference to the notion of representation.

As this brief summary suggests, the proposal advanced in Chapter 1 for a new account of the role of Embodied Simulation in language understanding, taking the role of the physical body in human cognition into account, seems to be different from the positions currently available in the field of metaphor studies. As for the definition of embodiment and its application to the field of metaphor studies, as I have anticipated, the body can contribute to cognition in at least two senses. In a first sense, it directly contributes to cognition as, for example, when sensorimotor contingencies shape perception; in a second sense, it contributes to cognition as the object of a representation, as for instance when conceptual representations of the body give rise to the metaphorical foundation of abstract concepts. These two levels of embodiment will be the object of discussion in the next chapter.

CHAPTER 3

Between embodiment and culture

Body schema and body image

3.1 Introduction

Our bodies can play different roles at different levels of our cognition. The aim of this chapter is to discuss the multifaceted nature of embodied cognition. For this purpose, I will rely on the distinction between a body schema and a body image (cf. Gallagher 1986, 2005, but see below). The notion of a body schema can be related to the mechanism of ESN. But it is not limited to it. Body images, by contrast, tap into mental representations of the body. Body schemas and body images are distinct but interacting notions. I propose that a first level of embodied cognition relies directly on body schemas while a second level relies on body images. Body images can recruit body schemas by means of Embodied Simulation. Embodied Simulation considered in the narrow sense, i.e., as a brain mechanism operating at the subpersonal level (ESN), allows us to redeploy processes related to the body schema. As was argued in Chapter 1, the contribution of the body, at this level, is not representational. But, when contextualized in a broader perspective (ESB), Embodied Simulation also leads to and determines contentful bodily experiences. And the latter, in the account presented here, are the missing link explaining how we go from neurons to conceptual and linguistic representations. Without taking into account the phenomenological body we could hardly understand how we can progress from contentless, neural mechanisms to contentful mental representations.

In the past decade, one part of the debate on Embodied Cognition has revolved around the metaphorical structure of our thought. CMT argues that many of our concepts are built metaphorically, starting from bodily-related knowledge (Lakoff and Johnson 1980, 1999; Gibbs, 2006b, 2011b). As we have seen in Chapter 2, we often describe love relationships in terms of journeys. LOVE IS A JOURNEY is a widely discussed example. According to the LOVE IS A JOURNEY metaphor, we conceptualize love by projecting onto this abstract concept our knowledge and experiences of physical journeys, involving, for instance, related metaphors like

CHANGE IS MOTION and PURPOSES ARE DESTINATIONS. Expressions like the following are very common when we talk about love relationships: "Look how far we've come. It's been a long, bumpy road. We can't turn back now." (Lakoff 1993, 2; see also Lakoff and Johnson, 1980 for a discussion of this examples). Other examples of conceptual metaphors built on our bodily experiences are HAPPINESS IS UP and AFFECTION IS WARMTH. In these cases we conceptualize happiness and affection by projecting features from the sensory experiences of being up and being warm respectively.

Metaphors, especially those related to our body, have been claimed to play a special role in structuring our cognition and are ubiquitous in language use. Linguistic research has shown that no fewer than one in eight words in all language use can be seen as expressing an underlying metaphorical thought (Steen et al., 2010). But how can we describe the role that our body plays in metaphorical cognition? This is beyond any doubt a central question in Embodied Cognition research and, as we have seen in the previous chapters, there is no agreement on this issue.

Giving an answer to this question is far from simple. It not only relates to the definition of Embodied Simulation, whether conceived of in a narrow or a broad sense, as has been discussed in Chapter 1, but also requires a clarification of what we mean by the term 'body'. Although the problem of defining the notion 'body' may seem trivial, the literature on this topic is quite full of controversy. Some preliminary questions therefore need to be answered before the issue of embodiment and metaphor can be addressed. For instance, does the body itself or some form of representation of the body play a role in metaphor processing (Alsmith & de Vignemont, 2012)? Is the role of the body explicit, conscious and played out at the personal level of our experiences, or is it implicit, subpersonal and unconscious? As we will see, the literature on this topic is ambiguous and many solutions have been proposed that provoke more questions.

A recurrent notion in this debate, and the most controversial one, is that of the 'body schema'. It was introduced in 1905 by the French neurologist Pierre Bonnier (de Vignemont, 2010) to refer to a form of representation of the body. 'Body schema' and related terms used interchangeably became some of the most frequently used expressions among neurologists (e.g., Berlucchi and Aglioti, 1997), philosophers (e.g., Merleau-Ponty, 1945), psychologists (e.g., Fisher 1972) and linguists (e.g., Lakoff and Johnson, 1980). The last-mentioned, in particular, developed the explicative role of the notion of an image schema, connected to the notion of a body schema, also in relation to the metaphorical structure of our conceptual system, and viewed the image schema as the source domain of many bodily metaphors. These bodily metaphors are considered to be the building blocks of our conceptual system (Lakoff and Johnson, 1980; Johnson, 1987).

But what precisely are body schemas? As Frédérique de Vignemont (2010) suggests, there have been different and partly divergent definitions of this notion. This variety of accounts has inevitably led to a degree of both conceptual and terminological confusion. In order to provide clarification, Shaun Gallagher proposed the distinction between body schema and body image (Gallagher, 1986, 2005; Gallagher and Zahavi, 2008; see also Dijkerman and de Haan 2007; Paillard, 1999). Gallagher and Zahavi's definition (2008, 164) states that the body image "is composed of a system of experiences, attitudes, and beliefs where the object of such intentional states is one's own body." The body schema, instead, is described by these authors as follows:

> […] it includes two aspects: (1) the close-to-automatic system of processes that constantly regulates posture and movement to serve intentional action; and (2) our pre-reflective and non-objectifying body awareness. So, the body schema is a system of sensorimotor capacities and activations that function without the necessity of perceptual monitoring" (Gallagher and Zahavi 2008, 165)

Gallagher and Zahavi's definition seems to suggest that the notion of body schema refers to the subpersonal processes enabling our movements while the body image is a set of representations of the body (i.e. representations having the body as their object) belonging to the personal level of our experience.

Empirical evidence in support of Gallagher's distinction is provided by the existence of neurological pathologies that can selectively affect the body schema (deafferentation; see Cole 1995; Cole and Paillard 1995; Gallagher and Cole 1995) or the body image (personal neglect; see Denny-Brown, Meyer and Horenstein 1952). Patients affected by deafferentation suffer from the loss of proprioception[1] and other sensory inputs from their body while they still have intact body images. As a consequence of this loss, these patients lose their body schema. They lack the ability to automatically regulate posture and movements. To be able to move and carry out even very simple actions, they need to constantly and attentively monitor their movements by means of visual perception and cognitive control of their limbs.

By contrast, patients affected by personal neglect have intact body schemas, as is shown by the fact that they can automatically regulate their movements and carry out even complex actions without any effort, but they lose the ability to represent a part of their body. If the personal neglect is caused by a lesion in the right hemisphere, they lose the ability to represent and recognize the left side of their body. This part is completely ignored and sometimes even denied. Patients with personal neglect usually take care of only half of their body, for example by

1. Proprioception is the ability to sense our own body and the position of its segments in space.

brushing their hair only on the right-hand side. But they are able to use the neglected side of the body to carry out actions related to the non-neglected part. They do not have any problem in coordinating and regulating their movements; in fact they exhibit an intact body schema in spite of the disruption of their body image. These pathologies suggest that, although body schema and body image certainly interact closely in non-pathological situations, the distinction between them is important both from a clinical and from a theoretical and empirical point of view.

What can this distinction tell us about embodied cognition and its relation to metaphor? I propose that a first level of embodied cognition relies directly on body schemas while a second level relies on the notion of body image. Thus, depending on the level of analysis that we choose, the body schema or the body image, our body plays a different role in cognition.

At the first level, the role of the body can be explained in terms of its function of structuring our perception and, as a consequence, our conceptual system which relies to a great extent, but clearly not completely, on our perceptual experiences. In this case, the body is not the object of our attention and explicit knowledge. Instead, it is the condition for action and knowledge to be possible. At this level, subpersonal sensorimotor processes are foundational to perception, and perception is, in turn, foundational to conceptual knowledge.[2]

Alva Noë's (2004) work on the role of the sensorimotor system in structuring perception is illuminating with regard to this point. He clearly and explicitly acknowledges the foundational role of the sensorimotor system in perception from the very first page of his thought-provoking book.

> Perceptual experience acquires content thanks to our possession of bodily skills. *What we perceive* is determined by *what we do* (or what we know how to do); it is determined by what we are *ready* to do. In ways I try to make precise, we enact our perceptual experience; we act it out. To be a perceiver is to understand, implicitly, the effects of movements on sensory stimulation. Examples are ready to hand. An object looms larger in the visual field as we approach it, and its profile deforms as we move about it. A sound grows louder as we move nearer to its source. Movements of the hand over the surface of an object give rise to shifting sensations. As perceivers we are masters of this sort of pattern of sensorimotor dependence. (Noë 2004, 1)

The first level of embodied cognition, grounded in the body schema, with its foundational role with respect to perception, is prior to any other kind of metaphorical embodiment in thought, language and communication. The foundational role of

2. The issue of the role of language in conceptual knowledge will not be addressed here (for a discussion of this issue see Cuccio and Gallese, 2018). I will only maintain that perception has a fundamental role in the structuring of conceptual knowledge.

the body (understood as the body schema) in cognition, at this level, is invisible because its function is that of making perception and, hence, knowledge of the world possible. During perception our body becomes invisible to us. It is only in particular circumstances that we focus our perceptual attention on our own body, when it is our body that requires our perception for specific purposes, such as pain or pleasure. In general, however, if we always had to pay attention to our body we would lose what perceptual experiences are about.

This also suggests that the basic relationship between our body and perception is metonymic: our perceptual experiences (e.g., sight, hearing, and so on) are related to subpersonal sensorimotor processes and the movements they enable (the body schema) via a correlation that is fundamental in nature. Perceptual experiences, when these are not distorted, are a function of the sensory apparatus we are equipped with and of the movements we carry out, grounded in and enabled by a set of subpersonal sensorimotor processes. The experience of sight, to give an example, implies a causal relation with specific patterns of movement of the eyes. These movements are foundationally tied to our ability to see, to the extent that if our eyes were paralyzed we could not see. Sight, like perception in general, is thus tied to sensorimotor contingencies by means of a metonymic relation. They are constantly connected by means of a foundational relationship, though this relationship is usually not visible to us. Perceptual experiences can hence metonymically stand for the subpersonal sensorimotor components constitutive of them. From now on, I will refer to this first level of embodiment as the level of invisible metonymies.

When referring to this level of embodied metonymic cognition, we should keep in mind that invisible metonymies take place exclusively at the cognitive level and do not have a linguistic counterpart. Our subpersonal sensorimotor system and the movements it enables structure our perception. But linguistically we do not describe perception in terms of sensorimotor contingencies. If we keep this clear, we can easily return to sender a potentially powerful objection that could be raised against the idea of embodied metonymic cognition. The objection could go, more or less, as follows. It has been argued that the body schema level, i.e. the subpersonal level of physical processes enabling our movements, is not representational; therefore, body schemas cannot have meaning, which prevents them from being the source domain of a metonymic mapping.

This objection would hit the target if it were claimed that the metonymic relation constituting the first level of embodiment implies the mapping of meanings with truth conditions from a source domain (the body schema level) to a target domain (perceptual experiences). However, I have never made this claim. The proposal advanced here is theoretically much less demanding. It is suggested that perceptual experiences (the target domain) are related to subpersonal sensorimotor processes (the body schema) via a relation of a foundational nature. The former are, thus, a function of our sensory apparatus and of the movements we perform. Our subpersonal sensorimotor processes structure our perception in the sense that, as Noë (2004, 1) has highlighted, *what we perceive* is determined by *what we do* and by what we are *ready* to do. The structure of our perceptual experiences (the target) comes from the structure of the set of subpersonal processes in which our movements are rooted. This relation can be considered to be metonymical, since it involves a transfer of structures from a source to target; however, no transfer of meaning is implied.

As for the second level of embodied cognition, it is metaphorical. At this level, the body image functions as a source domain for metaphorical mappings. In this case, the body is the object of our representations (i.e., it is the object of our experiences, attitudes and beliefs). Representations of the body thus become the source domain whose meanings we map onto a target domain in order to structure other concepts.

This level has been widely investigated in CMT. In this view, metaphor is a cognitive process that allows us to build our conceptual system. Many of the metaphorical meanings in our conceptual system are built on the basis of conceptual representations of bodily experiences.

> Metaphor consists of a source (b) and a target domain (a) such that the source is typically a more physical and the target a more abstract kind of domain. Examples of source and target domains include the following: source domains: WARMTH, BUILDING, WAR, JOURNEY; target domains: AFFECTION, THEORY, ARGUMENT, LIFE, respectively for the previous source domains. Thus we get conceptual metaphors: AFFECTION IS WARMTH; THEORIES ARE BUILDINGS; ARGUMENT IS WAR, LIFE IS A JOURNEY. What this means is that the concepts of affection, theory, argument, and life are comprehended via the concepts of warmth, building, war, and journey, respectively. (Kövecses 2015, 21)

As is illustrated by this quotation, the main claim in CMT is that we comprehend abstract concepts such as AFFECTION and LIFE via the *concepts* of WARMTH and JOURNEY. That is, we comprehend abstract concepts by projecting onto them features from our conceptual representation of bodily experiences. Thousands of pages have been written in recent decades about this central claim of CMT (i.e. about the idea that we comprehend abstract *concepts* via a metaphorical mapping from bodily *concepts*). The mapping goes from concepts to concepts, from representations of the body to other representations. In virtue of this, it is here suggested that work carried out in CMT exclusively refers to and describes the second level of embodied cognition.

In proposing this interpretation of CMT, there is another potential objection I need to steer clear of. It could be objected that CMT has also addressed the first level of embodied cognition in the form of so-called primary metaphors (Grady, 1997a, 1997b, 2005), which go from sensorimotor experiences to subjective experiences (see also Lakoff and Johnson, 1999). At first sight, the definition of primary metaphors introduced by Grady (1997b) could seem to come close to the definition of the first level of embodied metonymic cognition. Yet the two notions are quite different. In Grady's account (1997b, 2005), primary metaphors originate from stored patterns of association between physical experiences and emotional experiences (Grady, 2005). These associations, in Grady's view, take place at the conceptual level (Grady 2005, 1600).

> The correlation between emotion and skin temperature is real and experienced. We feel warm when our emotions are aroused, and we feel warm when we are close to other people, as we are when we interact intimately. There is a *conceptual association between coldness and lack of feeling*, not because interacting with a cold object and interacting with an unfeeling person are perceived as similar experiences, but because through recurring experience *we associate the conceptual domain of temperature with that of emotion*. (Grady 2005, 1600)

In Grady's own words, primary metaphors originate from the association of conceptual domains related to physical experiences with conceptual domains related to emotion and other subjective, non-physical, experiences. Thus, while invisible metonymies at the first level of embodiment have body schemas (i.e. a set of subpersonal mechanisms) as their source domain, the source domain of primary metaphors is a phenomenal experience, an experience of our physical body, which we conceptualize and project onto a different, non-physical, but still subjective personal-level experience. Hence, in primary metaphors, the physical body, with its phenomenological features, becomes the object of a conceptual representation. It follows that the source domains of primary metaphors are body images: in the primary metaphor account, the body contributes to cognition by itself being an object of knowledge.

This view of primary metaphors as a correlation of concepts has been confirmed by Grady and Ascoli (2017).

> CMT has assumed that the link between the concepts paired in a primary metaphor is rooted in highly regular correlations in experience, such as those between the weight of an object and our ease or difficulty in handling it in the case of DIFFICULT IS HEAVY. Similarly, the metaphor POWER/STATUS IS UP plausibly originates in the advantages offered by higher spatial position when it comes to dominating another (given the effects of gravity). In the case of HAPPY IS BRIGHT, there is a clear experiential correlation between personal mood and ambient brightness. (Grady and Ascoli 2017, 28)

> Both the source and the target concept of a primary metaphor are equally basic concepts, which differ from each other only with regard to whether they are ultimately grounded in a particular sensorimotor domain.
>
> (Grady and Ascoli 2017, 29)

The same conclusions can also be drawn from reading Gibbs's interpretation of primary metaphors. Indeed, Gibbs (2014), in line with Grady (1997a, 1997b, 2005), defines primary metaphors as *experiential* correlations (i.e. personal-level, contentful states):

> One important development in the study of embodied metaphor is the discovery of primary metaphors (Grady, 1997b). Primary metaphors arise from our experiential correlations on the world. Thus, similarity is not the basis of primary metaphor but co-occurrence. For instance, the conceptual metaphor MORE IS UP (e.g. 'Inflation is up this year') correlates having more of some objects or substance (i.e. quantity) with seeing the level of those objects or substance rise (i.e. verticality). Primary metaphors include mappings such as INTIMACY IS CLOSENESS (e.g. 'We have a close relationship'), DIFFICULTIES ARE BURDENS (e.g. She's weighed down by responsibilities), and ORGANIZATION IS PHYSICAL STRUCTURE (e.g. How do the pieces of the theory fit together). In each case, the source domain of the metaphor comes from the body's sensorimotor system. (Gibbs 2014, 170)

There is, however, one aspect in Gibbs's (2014) passage that needs to be carefully analysed. On the one hand, Gibbs defines primary metaphors as experiential correlations. This means that both the source and the target domain of primary metaphors are experiences (physical experiences, in the case of the source domain; subjective, non-physical experiences in the case of the target domain). Both of them are thus personal-level phenomena. Then, in the last line of this quotation, Gibbs claims that the source domain of primary metaphors "comes from the sensorimotor system". On the basis of this statement, one might think that the source domain of primary metaphors is the body schema (Gibbs explicitly refers to the sensorimotor system). It could therefore be inferred that primary metaphors also refer to the first level of embodiment as is the case for invisible metonymies. Now, as we know, the sensorimotor system is a subpersonal system, whose activity gives rise, contextualized in a broader framework, to personal-level experiences. However, the sensorimotor system *per se* is not a personal-level experience nor can the sensorimotor system *per se* represent personal-level experiences because it does not have representational power, as argued in the first chapter. It follows that if we regard primary metaphors as experiential correlations, their source domain is a personal-level experience and primary metaphors therefore occur at the second level of embodied cognition. If we consider the sensorimotor system to be the source domain of primary metaphor, then primary metaphors cannot any more be regarded as experiential correlations. Generally speaking, a sensorimotor *experience*, i.e. an experience that originates from the sensorimotor system, is a very different thing from the sensorimotor system *per se*, and these two dimensions should not be conflated.

Last but not least, in order to rebut the objection that primary metaphors are also grounded in the first level of embodiment described in the preceding pages, we should bear in mind that, contrary to what is the case for invisible metonymies, primary metaphors have a linguistic dimension.

At the second level of embodiment, to which also primary metaphors belong, then, the contribution of the body to thought and language is not direct. The body contributes to cognition in the form of an object of knowledge (an experience, an attitude or a belief that has the body as its object) which is then mapped onto a different domain. The contribution of the body, then, is mediated by our cultural, environmentally situated and linguistically structured representations of the body itself. Body images can be conscious representations, but they do not necessarily have to be so. However, importantly, even if they are unconscious, personal-level phenomena, body images can always be brought into consciousness.

From now on, I will refer to this second level of embodied cognition as the level of visible metaphors. Visible metaphors are fully an expression of the contribution of our bodily knowledge to the structuring of the conceptual system and occur at the second level of embodiment. It must be acknowledged, however, that the metaphorical origin of concepts is not the only account of concept formation that has been provided in the literature. An analytical discussion of other accounts of concepts, however, lies outside the scope of this book (for a deeper examination of this point, see the special issues of *Philosophical Transactions B* edited by Borghi et al., 2018 and of Topics in Cognitive Science edited by Bolognesi and Steen, 2018 on abstract concepts). I will here not address alternative approaches to concept formation that might be grounded in the sensorimotor system. As for metaphorically built concepts, since these are the product of a mapping between two conceptual domains (and this seems to hold true even of primary metaphors, as we have seen in the preceding pages), it will suffice to remark again that the body, in this case, is necessarily already an object of knowledge and as such its role is mediated by cultural, environmental and linguistic features. Metaphorically built concepts definitely lie at the second level of embodiment.

This chapter aims to explain the relevance of the distinction between body schemas and body images to the debate on embodied cognition and metaphor. In the rest of the chapter I will first analyse the notions of body schema and body image (Section 3.2) and then will discuss in greater depth the different but complementary forms of embodiment that rely on them, i.e. invisible metonymies and visible metaphors (Section 3.3).

3.2 Body schema and body image: A conceptual clarification

The notions of body schema and body image have been widely used, often interchangeably, by neurologists, neuroscientists, philosophers, linguists and psychologists (for a review, Tiemersma 1989; for a short survey on this topic, Gallagher 2005). As Gallagher has emphasized (2005, 21), the most confusing and ambiguous aspect of the definition of a body schema and/or a body image is the notion of consciousness. To what extent is consciousness a necessary feature of a schema or image of the body? The answers to this question have been quite divergent. The notion of a schema or image of the body, Gallagher suggests (2005, 23), has been described as (a) a subpersonal phenomenon occurring at the neural level, (b) a conscious mental representation, (c) an unconscious representation or (d) as the way we organize our bodily experiences. To make things worse, even in the work of single authors the use of the notions of a body schema and a body image is often not consistent (Tiemersma, 1989; Gallagher, 2005).

It needs to be pointed out that the conceptual confusion between the notions of body schema and body image might point to a deeper theoretical problem: authors have often collapsed the two different levels of embodiment described in the previous section. For instance, Lakoff and Johnson (1980, 256: second edition) say that metaphor, i.e., a conceptual representation, is a neural phenomenon, i.e., a subpersonal physical state. But a conceptual representation cannot be merely reduced to a state of the brain. There is not a simple correspondence between concepts and brain states. Or, at least, as has been argued in Chapter 2, we do not have so far identified the principles that could allow this reduction from concepts to brain states.

It is therefore of paramount importance to keep the different levels distinct at which our body contributes to cognition. I will therefore embrace Gallagher's distinction between these two terms. Clarifying the notions of body schema and body image is a preliminary step that must be taken before I can discuss the role of the body in relation to embodied cognition and its relation to metaphor. It is important to note that, although they are conceptually distinct, the boundary between body schema and body image is not so rigid in our cognitive processes. Our beliefs and concepts about our own body, for example, can have effects on our perception and movement in space. In this case the body image affects the body schema. Of course, in particular circumstances, for instance when we are facing a situation of particular physical effort (for example during sports training), it is also possible for us to focus our attention on specific motor patterns that are usually below the threshold of awareness. In such a case, the body schema functions are affected and modulated by perceptions of our own body (for instance, sport trainings leads to the formation of new motor programs). In what follows, I will discuss the distinction between body schema and body image with the aim of clarifying the difference and the relation between them and fostering a deeper understanding of the role of the body in embodied cognition.

3.2.1 The body schema

"The body-schema is a system of sensory-motor processes that constantly regulate posture and movements – processes that function without reflective awareness or the necessity of perceptual monitoring." This is one of the definitions of body schema provided by Gallagher (2005, 37). The concept of a body schema refers, in his terms, to the sensorimotor processes that allow us to move and constrain our movements. In this sense, the body schema does not refer to an image of the body. It is not the result of our perception of our own bodies. Instead, the body schema is the sum of those sensorimotor processes that allow us to navigate and perceive the world. In this sense, the body schema is not a perceptual or mental image of the body. When using this notion, Gallagher refers to the motor abilities that underlie and are foundational to action and perception. The body schema, thus, does not involve consciousness or perceptual monitoring.

In fact, the motor abilities that enable intentional actions are rarely the object of our conscious reflection (and the subpersonal mechanisms on which they are implemented are never object of conscious reflection). Unless something does not work in the right way or unless we are facing the task of learning a new motor pattern, for example a dance step, we do not generally focus our attention on the body and on the processes underlying action and perception. To make this point clear, let us think of what we normally do when we walk. We know that we need to move one foot after the other in a certain direction. However, while we are walking, we do not usually need to be aware of this background knowledge or need to focus our attention on our legs and on our feet to calculate the exact distance in space we need to move or to estimate how to balance the weight of our body on one foot when the other is moving forward, and so on. Even though we are not aware of what we do in order to walk, we are usually able to walk and to effortlessly adjust our movements to the ground. We do not lose our balance if the surface we are walking on is not completely regular, or at least we do not fall down all the time. To avoid this risk and to make our movements faster and safer, there is a set of subpersonal mechanisms, proprioception *in primis*, that allow us to register the inputs we get from the outside and, on this basis, to regulate what we need to do in order to move through the environment (Haggard and Wolpert, 2005).

In such processes the body itself is rarely the object of attentional awareness. Of course, we can suddenly have a physical problem, such as a severe pain in a leg, which will not allow us to move any more. In such cases we may fall down or lose our balance and need to give conscious attention to our body and its movements in order to be able to walk again. But this is not the norm. Pain, together with other peculiar circumstances related to, for example, fatigue, sex or sickness, or even to philosophical introspection or medical investigation, are limiting cases in which the body itself comes to be at the focus of our attention. When the body enters our perceptual field, becoming the object of our perception, we are dealing with something else, namely our perception and conceptualization of our body, which is here called our body image.

In sum, the body schema, being a set of sensorimotor processes, is not an image of the body but the precondition of the possibility of action and, as such, of perception (Noë, 2004). According to Gallagher, the body schema, i.e. the set of our sensorimotor processes, is not a cognitive operation but it can support cognitive activities.

What are the sensorimotor processes constituting our body schema? According to Gallagher (2005, 45), there are three functional systems operative here. The first is the system responsible for the processing of information about posture and movement (see also Haggard and Wolpert, 2005). Information about posture and movement comes from different sources, primarily proprioception. Somatic proprioception is the main kind of information we use here. We get proprioceptive information from kinetic, muscular, articular and body surface sources thanks to receptors located in the muscles, joints and the skin. Vestibular[3] and equilibrial functions and the sense of sight are also sources of proprioceptive information. In the latter case, we automatically register visual information about the movement of our own body in the environment.[4] It is worth noting here that proprioceptive information is defined as a set of physiological, subpersonal and unconscious processes that lead to proprioceptive awareness. In some pre-reflexive sense, we are always aware of the position of our body but this awareness is rarely the result of an explicit act of reflection.

The second functional system of a body schema is that responsible for the production of motor programmes and movement patterns (output; Paillard, 2005). We have a number of motor habits. Some of these are innate, such as swallowing, while others are learned, such as writing. A motor programme can be described at the neural level as the activation of neural circuits in the motor cortex which, at

3. The vestibular system comprises the inner part of the ear and the vestibular cortical network in the brain. It has been suggested (Lopez, 2016) that, besides the function of balancing the body, this system also contributes to modulating awareness of space, the body and the self.

4. The sense of sight, however, can also be a source of explicit information when we directly focus our perceptual attention on the position of our limbs. But these are cases of a form of body image.

the behavioural level, enables the execution of single motor acts that taken together constitute the chain leading to the execution of a motor action. The processing of proprioceptive information is essential for the production of motor patterns. We constantly need feedback about our body posture to efficiently move through the environment. If we did not receive inputs from our proprioceptive system we could not fluidly adjust our movements to the current environmental situation.

The third functional system of a body schema pertains to cross-modal communication. We have an innate ability to transform visual inputs into motor competence. This means that when we observe other people's actions, this visual stimulus is immediately and automatically translated into motor terms. This translation is realized by means of mirror neurons which, as we saw in the previous chapters, are neurons in the pre-motor cortex that respond both to action observation and to action execution (di Pellegrino et al. 1992).

Summarizing, the notion of body schema refers to a set of subpersonal sensorimotor processes that operate without any need for attention and conscious awareness. These systems are responsible for the execution and constant monitoring of our movements. Our movements, as we have seen, are thus a necessary condition for perceptual experiences.

3.2.2 The body image

"The body-image consists of a complete set of intentional states and dispositions – perceptions, beliefs and attitudes – in which the intentional object is one's own body" (Gallagher, 2005, 25). As is suggested by this definition, different types of intentional relations can be involved in the constitution of a body image. At least three different configurations can be distinguished.

First, the body can be the object of a perceptual state (*body percept*). When we move around, perceiving the world, for example when we look at a beautiful landscape from a mountain top, we are usually not aware of our body. It becomes invisible to us as long as we are completely absorbed in the breath-taking beauty of the landscape. This is when the first foundational level of embodied metonymic cognition remains invisible. This means that the body, with its sensorimotor processes, makes our visual experience (the beautiful landscape we are admiring) possible, but our own body is not the object of our perceptual experience in this situation. What is more, it is the very fact that the body hides itself in this process that enables our visual experience.

But if a speck of dust suddenly enters our eye and this starts to hurt, or if we feel an unexpected and irritating itch in one of our feet, the eye or the foot becomes the object of our perceptual attention and of our efforts to relieve the discomfort. This is an intentional relation with our own body in that our own body is now the object of our perceptual state. It clearly also implies some form of consciousness. We are perfectly conscious of our eye or of our foot and of how it feels to have an unpleasant sensation in it. This kind of epistemic access to our body is from the first-person perspective (Pauen, 2012).

The notion of consciousness deserves explanation. Consciousness is certainly a tricky concept, especially when used by philosophers. To make it as clear as possible what I mean by consciousness I will refer here to the work of Ned Block (2005), who distinguishes between phenomenal consciousness and access consciousness. The former notion indicates the percept, the content of an experience (e.g. red, green, or, indeed, an itch in one foot). The latter points to "contents information about which is made available to the brain's 'consumer' systems" (Block 2005, 47). The latter is, in other words, the information as it is encoded in the brain, as Michael Graziano would say (2013, 53). Thus, access consciousness is being aware of something, with reference to the neural mechanism enabling this process; phenomenal consciousness is knowing that we are aware of something. The acceptation of consciousness that goes with our perception of our own body (e.g., when we consciously feel pain or pleasure or when we consciously feel an irritating itch in one foot) is definitely phenomenal consciousness.

Second, the body can be the object of our conceptual knowledge (*body concept*). This happens when it is accessed from the third-person perspective (Pauen, 2012). When we open a handbook of anatomy and we start to study the structure and composition of the human body, this becomes the object of our conceptual understanding. We cannot know how it feels to have neurons firing but we have a scientific description of this neurophysiological process. This is also an intentional relation, in that the body is the object of our explicit knowledge and beliefs. It also involves attention and consciousness, even though it is not precisely what Block has called phenomenal consciousness inasmuch as the body is not a perceptual object but the object of a belief.

Of course, our scientific knowledge about the body does not always imply attention and consciousness. We do not always consciously have the functions and processes of the nervous system or of other parts of the body present in our mind and we usually are not required to pay attention to them. But this knowledge, according to Gallagher (2005), is part and parcel of a set of beliefs and attitudes that, even unconsciously, enters into an intentional relation with the body considered as an epistemic object. In other words, the body is an object of knowledge (think, for example, of our knowledge of anatomy, if we are medical students), even though this knowledge is not always consciously present in our minds. But it is stored in our memory and it can be retrieved whenever we want. When this is needed, we can always attend to this knowledge.

Attention, in this case, works as a lens that allows us to focus on this knowledge and retrieve it from the unconscious to a potentially conscious dimension. Michael Graziano (2013), with regard to this point, has provided a model that clearly explains how attention selects signals to focus on and explained that there are two kinds of signals: bottom-up and top-down signals. The kind of signal that has been discussed in the previous lines (with the example of anatomy) is a top-down signal: *we decide* to focus our attention on an idea or belief, in contrast to bottom-up signals such as "the brightness or the sudden onset of a stimulus, which can cause the representation of that stimulus in the brain to gain signal strength and win the competition" with other signals (Graziano 2013, 60–61). I will come back to the notion of attention in greater detail in the last chapter of this book. For now, leaving aside the representational lexicon that Graziano uses to describe brain process, I will refer to his description of what attention is and how it works:

> In essence, attention is a process by which a brain seizes on a signal, focuses its intelligent computation on that signal, processes the signal in a deep manner, has its cognitive machinery driven by that signal, and tends to control behavior on the basis of that signal. The target of attention need not be a visual stimulus. Indeed, it needs not even be any kind of sensory stimulus. It is possible to attend to an idea, a movement, an emotion, a belief, a memory, a smell, a taste, a sound, a sight, or an object that combines all of those properties. Attention is a general way to handle data and can apply to a range of information domains. It is an enhancement operation and a selection operation performed on signals in the brain.
> (Graziano 2013, 61)

Interestingly, scientific knowledge is not the only source of conceptual knowledge about the body. Commonsense beliefs are an equally important part of our conceptual understanding of the body. In this regard, it may be useful to note that commonsense beliefs and scientific knowledge are constantly interacting with one another. What scientific research has revealed to us about the body influences, in a slow but constant process, our commonsense understanding of the body. This is true because our beliefs are inevitably historically, linguistically and culturally situated and the advances and results of scientific knowledge are an integral part of our historical, linguistic and cultural environment.

Third, the body can also be the object of an emotional attitude (*body affect*). This is the case when our feelings, positive or negative, have the body as their object. Many of us look in the mirror every day and this routine action is usually associated with a positive or negative feeling, according to our mood of the day and to many other variables. We like what we see or we do not. This feeling towards the body is an intentional relation: the body is the object of an emotional state. We could pay attention to it and make it conscious but it is very often unconscious.

It is of great importance to note that our feelings and attitudes towards the body are inevitably affected by our body concept, that is, by our beliefs about the body. If we live in a society where the standard of beauty is a thin and athletic body and we do not match up to that standard, this can lead us to have negative feelings towards our body. It is also possible and fairly common for our feelings towards our body to influence and affect our perception of our own body and our beliefs about and conceptualization of it. Body affect, body concept and body percept are three different but deeply interconnected aspects of our image of the body. The body image, then, is a set of interconnected intentional states in which each type of intentional relation with the body affects and influences the others and all of them are deeply situated in a historical, linguistic and cultural environment. The image we have of our own body is inevitably the result of our being situated in a specific context, taking the notion of context in its broader acceptation as a physical, linguistic and cultural environment.

It is important to note that the body image is almost always a partial representation of the body: our perception, emotional attitude or conceptualization of the body is usually directed towards a part or a single aspect of the body at any one time, as in the case of an itch in the foot. We single out one aspect of our bodily experience and this aspect or part then becomes the object of a representational state.

In sum, body images are representations that have the body as their object. These representations can have different characteristics: the body can be the object of a perceptual state, it can be the object of conceptual knowledge or it can be the object of an emotional attitude. In all of these variants, it is the object of an intentional relation because it is the object of our representations. And it can be the focus of our attention and consciousness.

3.3 Levels of embodiment

Making a conceptual distinction between body schema and body image is a preliminary step towards understanding how embodiment contributes to cognition and to its relation to metaphor. In this section I propose a distinction between two levels of embodiment that rely on body schemas and body images respectively. On the first level, which relies on body schemas, the physical body directly contributes to perception and, as a consequence, to cognition. No representational mediation is at play here. The relation between body schemas and perception is described in terms of a metonymic correlation. Importantly, this is a *correlation* and not merely a *causal relation*. In the case of a merely causal relation, we would have no need to have recourse to the notion of metonymy. Evidence showing that this is a metonymic correlation comes, for instance, from the fact that we need to learn how to link sensorimotor abilities and perceptual experiences. There is no mere causation (with such and such sensorimotor contingencies determining such and such perceptual experiences) that would make any learning process not really relevant. The correlation between body schemas and perceptual experiences needs to be built during our cognitive development, with practice. Proof of this is the fact that congenitally blind individuals who have had their sight surgically restored are unable to see immediately after the surgery even if they are perfectly capable of receiving visual stimuli:

> What we learn from the case studies is that surgery restores visual sensations, at least to a significant degree, but that it does not restore sight. In the period immediately after the operation, patients suffer blindness despite rich visual sensations. […] none of them, in having these sensations, has acquired the ability to see, at least not in anything like the normal sense. The visual impressions they now receive remain confusing and uninformative to them, like utterances in a foreign language. […] In normal perceivers, sensation is smoothly integrated with capacities for thought, and for movement; so, for example, we naturally turn our eyes to objects of interest, we modulate our sensations with movement in a way that is responsive to thought and situation. (Noë 2004, 4–7)

At the second level of embodiment, which relies on body images, the body contributes to cognition while it already is the object of a mental representation (as we have seen, perceptions, beliefs and attitudes towards the body). Our knowledge of the body, represented in our body image, forms a basis for building typically more abstract conceptual meanings. This gives rise to embodied metaphorical cognition. In this view, as has already been argued, both primary and complex metaphors pertain to the second level of embodiment. Thus, while primary metaphors (e.g. INTIMACY IS CLOSENESS, HAPPINESS IS UP, CHANGE IS MOTION) need to be distinguished from complex metaphors (e.g. LOVE IS A JOURNEY, THEORIES ARE BUILDINGS), they both have body images as their source domain for reasons that have already been explained.

The meaning of the term 'embodiment' is clearly quite different on these two levels. On the first level, it refers to the foundational role of the sensorimotor system in our perceptual experiences and, hence, in cognition. By contrast, on the second level, it refers to the role of culturally, environmentally and linguistically mediated conceptual representations of the body in the formation of the conceptual system. These conceptions of embodiment are complementary and both are at play in human cognition.

3.3.1 Body schema and invisible embodied metonymies

As we have seen, the notion of body schema refers to the set of sensorimotor processes that enable us to interact actively with the environment. Some of these functions are innate. Developmental studies (Meltzoff and Moore, 1977, 1983, 1989; see Gallagher 2005 for a discussion) broadly support this claim. The hypothesis that is presented here is that body schemas are the basic and ontogenetically primary source of metonymic correlation via a mapping from sensorimotor processes to perception (and, from there, to cognition). Invisible embodied metonymies give life to cognition by founding our perceptual experiences (the target domain) on our sensorimotor processes (the source domain). We discussed the example of sight some pages back. The same holds true for the other senses. The experience of touch, for instance, depends on movement because the stimuli that we receive depend on the movements we perform. We have the experience of touch when we move in relation to something. In the experience of touch, then, there is an intrinsic relationship between movements, enabled by body schemas, and the perceptual experience we have. It is, indeed, movement that makes perception possible.

Body schemas are, then, the source domain of a metonymic correlation that gives shape to the first level of embodied cognition. This is possible because the sensorimotor functions that enable us to interact actively with the environment and that constitute the body schema are foundationally correlated to our perceptual experiences. Every perceptual experience requires a degree of movement. Perceptual experiences are a function of the perceptual apparatus we are equipped with and of the stimuli we receive. But they are unequivocally also functions of our movements and of the subpersonal mechanisms enabling these movements.

Importantly, in this metonymic relation, we do not map meanings from the source to the target domain. The source domain is, in fact, constituted by subpersonal sensorimotor processes. What we map, then, is a non-meaningful (i.e., non-representational) matrix of sensorimotor abilities that give structure to the stimuli we receive from the environment, thus allowing and founding our perceptual experiences. Meaning only enters the picture when we master how to correlate this matrix of sensorimotor abilities with perceptual stimuli.

As I have already argued, the mapping from the sensorimotor level to the level of perception is likely to be foundational and constitutive in nature. Our perceptual experiences are always functions of our movements. For this reason, perception should not be thought of as a passive registration of inputs coming from the outside. Perception needs to be enacted and, as it has already been suggested, this is the case even for vision, which, *prima facie*, might seem to be the most passive perceptual modality. As Alva Noë (2004, 2) has pointed out, vision is very often the paradigm we use when we think about perception and it is often thought of in terms of a photographic model. According to this model, when our eyes are open, we passively receive inputs from the outside. However, this is not the truth. There is empirical evidence that shows that if our eyes are paralyzed, this causes blindness (Noë 2004, 13). Vision requires saccades and microsaccades many times per second to make us able to see the world. These constant movements of the eyes are constitutive of vision. Furthermore, it has also been shown (Held and Hein, 1963) that perception does not merely require movements of our body in relation to the surrounding environment. It also requires self-actuated movements (Noë 2004, 13). From this point of view, perception is grounded on and constrained by our sensorimotor processes.

I define this first level of embodied cognition as having a silent and invisible power. In this sense, our bodily capabilities are the glasses through which we look at the world. The body, at this level, is not the object of our attention and explicit knowledge. It is, instead, the precondition of the possibility of action and, as a consequence, of perception and knowledge.

What is important is that this first and primary level of embodied metonymic cognition does not reveal itself on the linguistic dimension. It is at play in our perception of the world, being the condition of its possibility and is thus foundational to any other explicit level of embodied figurative cognition.

The hypothesis advanced here differs significantly from the proposal of CMT. Contrary to what I have been proposing, CMT describes the first foundational level of embodied cognition in terms of metaphorical thought with the body contributing to the metaphorical mapping as the object of a representation. In the CMT view, metaphors are the basis of embodied cognition and they are conceived of as cross-domain mappings realized, at the neural level, as co-activations of brain areas that give rise, at the conceptual level, to directional mappings from a conceptually represented sensorimotor source domain onto more abstract domains. The fact that CMT considers the foundational dimension of embodiment to take place at the level of body images (i.e., at the level of our representations of the body) is clearly stated in the following paragraph from Gibbs (2006b). The author defines image schemata, the source domain of conceptual metaphors, as experiential gestalts. These:

> […] emerge throughout sensorimotor activity as we manipulate objects, orient ourselves spatially and temporally, and direct our perceptual focus for various purposes. Image schemas can generally be defined as dynamic analog representations of spatial relations and movements in space. Even though image schemas are derived from perceptual and motor processes, they are not themselves sensorimotor processes. Instead, image schemas are "primary means by which we construct or constitute order and are not mere passive receptacles into which experience is poured" (Johnson, 1987, 30). In this way, image schemas are different

> from the notion of schemata traditionally used in cognitive science, which is of abstract conceptual and propositional event structures (see Rumelhart, 1980). By contrast, image schemas are imaginative, nonpropositional structures that organize experience at the level of bodily perception and movement. Image schemas exist across all perceptual modalities, something that must hold for there to be any sensorimotor coordination in our experience. As such, image schemas are at once visual, auditory, kinesthetic, and tactile. At the same time, image schemas are more abstract than ordinary visual mental images and consist of dynamic spatial patterns that underlie the spatial relations and movement found in actual concrete images. (Gibbs 2006b, 90–91)

For example, to conceptualize affection we rely on the physical experience of warmth, usually associated, very early on in our lives, with emotional closeness and affect. Clearly, in the case of complex metaphors, such as when we conceptualize love relationships in terms of journeys, the representational character of both the source and the target domain is even more evident. In this case, we project our knowledge of physical journeys onto our concept of love.

These two examples imply a different relation between a conceptually represented sensorimotor source domain and a more abstract target domain. The primary metaphor example, as we have seen before, is experientially motivated (it is a correlation between two experiences that usually co-occur: a physical experience and a subjective, non-physical, experience). It is interesting to note that, in its standard view, CMT seems to not account for the modality of the constitution of perceptual experiences. Perceptual experiences, for example warmth (see Grady, 1997a, 1997b, 2005, also Grady and Johnson 1997) seem to be a starting point that is taken for granted. What I claim here, by contrast, is that we also need to account for the constitution of perceptual experiences and I propose that this basic and primary level of cognition implies a metonymic description: the mapping, as already anticipated, goes from the body schema, that is the set of sensorimotor processes that allow us to move, to perception. Our perceptual experiences are built on this metonymic correlation.

As for the example of the complex metaphor, by contrast, this is not directly experientially motivated. The difference between primary and complex metaphors will be discussed in greater detail later in this chapter. What is important for now is to acknowledge that, in CMT, every kind of conceptual metaphor implies a relation between two conceptually represented domains. Insofar as the metaphorical mapping is described as taking place at the conceptual level, a level in which our body is the object of a conceptual representation, its contribution to cognition is mediated by this representational dimension. On the contrary, as is the case for non-representational body schemas, constituting the source domain of invisible metonymies, the body directly contributes to cognition.

From this point of view, it does not make any difference that conceptual metaphors are then identified with patterns of neural activation in the brain. Unequivocally, metaphors in CMT are mappings between conceptual representations. And, even though conceptual metaphors are identified with, or even reduced to, patterns of activation in the brain, these patterns of activation are considered to be representations of the body that we can map onto other representations. On the contrary, the level of embodied metonymic cognition described here is prior and foundational to any representational level; as a result it is also prior and foundational to the level of conceptual metaphors.

It should be noted that the mapping from sensorimotor processes to perception can be exploited even when we are not carrying out any overt movement, by means of the mechanism of Embodied Simulation (Gallese, 2008; Gallese and Cuccio, 2016; Gallese and Lakoff, 2005). We reuse our sensorimotor system to carry out many cognitive tasks. Action understanding and social cognition, mental imagery and language comprehension, in the case of action-related language, all imply activation of the mechanism of Embodied Simulation (presumably ESN and ESB). This means that in all of these cases, to solve the cognitive task we are facing, we exploit our sensorimotor system and its foundational relation with perceptual experiences, even if we are not actively carrying out any action.

What is important here, however, is that standard versions of CMT, as well as PMT, as it has been argued in the previous chapter, seem to attribute to the mechanism of ESN a semantic content and, hence, a representational nature:

> We will argue that conceptual knowledge is embodied, that is, it is mapped within our sensory-motor system. We will argue that the sensory-motor system not only provides structure to conceptual content, but also characterises the semantic content of concepts in terms of the way that we function with our bodies in the world.
> (Gallese and Lakoff 2005, 456)

As noted before, this definition of the role of Embodied Simulation in human cognition collapses the neural and the conceptual levels. It inevitably leads scholars into the theoretical problems discussed in the first and second chapters of this book.

In the light of these considerations, I propose that we can only understand the real contribution of Embodied Simulation if we reframe our understanding of this mechanism in keeping with the definition proposed in the Chapter 1. ESN refers, strictly speaking, to the activation of mirror or canonical neurons when we are not actively engaged in actions, perceptions or emotional experiences. ESB refers to the activation of this mechanism in a broader framework that comprises both other brain activities and content involving bodily features (bodily sensations and personal experiences) as opposed to merely neural ones. The level of embodied metonymic cognition is the foundational level at which the physical body directly contributes to cognition. Body schemas are not representations of the body but they can be recruited by cognitive tasks that also involve representations of the body. I will discuss the role of the body in human cognition as the object of conceptual and linguistic representations in the next section.

3.3.2 Body image and visible embodied metaphors

The second level of embodied cognition is the level of metaphorical cognition. Metaphorical cognition takes place at the personal level of our experience. This means that cognition at this level might be conscious but it does not have to be. What is important is that even unconscious processes at this level can become conscious. This may happen, for example, *ex post*. If something goes wrong or, if we are explicitly asked, we are in principle able to track back our thought processes and bring them to consciousness.

Conceptual metaphors have body images as source domains. The power of such metaphors can be considered audible and visible, in comparison with the silent and invisible power of embodied metonymic cognition based on the body schema. In metaphors that have a body image as a source domain the power of the body is visible and audible because the source of the metaphor is our body as an object of representation and knowledge. Indeed, the source of the metaphorical mapping is a representation of the body, seen as a body percept, body affect or body concept. As such, the metaphorical mapping takes place at the conceptual level, from one representation to another. For this reason, in the case of metaphors with a body image as their source domain, the contribution of the body is mediated by our cultural, environmentally situated and linguistically structured representations of the body itself. This is fundamentally different from the case of embodied metonymic cognition, which is based on the body schema as a source domain, so that the contribution of the body to cognition can be considered direct, not mediated by any representation.

As we have seen, Grady's (1997a, 1997b, 2005) primary and complex metaphors both have body images as source domains. In fact, as noted above, in Grady's terms a primary metaphor is realized by means of a correlation between the conceptual domain of a physical, sensory, experience and the conceptual domain of a subjective, non-sensory, experience. The metaphorical mapping thus takes place at the conceptual level. The body, in this account, seems to contribute to metaphor processing as an object of knowledge.

The difference between primary and complex metaphors can be, and needs to be, accounted for at this level, too. Metaphors such as INTIMACY IS CLOSENESS or AFFECTION IS WARMTH are classic examples of experientially motivated primary metaphors in which we associate two different conceptual domains related to fundamental dimensions of experience. Complex metaphors, by contrast, are not directly motivated experientially. They are a combination of primary metaphors and other complex concepts and culturally embedded beliefs (Nin Yu 2008 for a discussion). Standard examples of complex metaphors are long-discussed conceptual metaphors such as LOVE IS A JOURNEY or THEORIES ARE BUILDINGS. The metaphorical mapping in this case also takes place at the conceptual level.

Thus, both primary and complex metaphors have a body image as source domain. Yet it would be unfair to collapse Grady's two levels of metaphors. A key element in the difference between primary and complex metaphors is the role of context in both of them. I propose that both primary and complex metaphors are contextually determined, but in very different ways (see also Kövecses, 2015).

The role of context in metaphorical conceptualization is a classic and hotly debated topic in CMT and PMT (Lakoff, 2008) and today a huge amount of data on cross-cultural variation suggests that conceptual metaphors vary significantly across different cultures (Alverson, 1994; Kövecses, 2005, 2010; Rakova 2002). However the claim of the universality or near-universality of conceptual metaphors is present in CMT and PMT, as is clear from the following passage:

> Grady called such metaphors "primary metaphors" and observed that they are learned by the hundreds the same way all over the world because people have the same bodies and basically the same relevant environments. Therefore, we will have very much the same experiences in childhood in which two domains are simultaneously active, and so we will learn neural metaphorical mappings linking those domains naturally, just by functioning in the world. Just living an everyday life gives you the experience and suitable brain activations to give rise to a huge system of the same primary metaphorical mappings that are learned around the world without any awareness. (Lakoff 2008, 26)

As this passage suggests, PMT seems to be especially committed to the idea that primary metaphors are universal and that their universality relies precisely on the universality of our bodily experiences. We all have more or less the same bodies and similar relevant environments, and during our childhood the same connections between domains are likely to be built (Lakoff, 2008). We all have had the physical experience of being up when we are happy. We all have had the physical experience of warmth when we feel affection. Hence, according to Lakoff (2008), this first level of metaphorical conceptualization is universal and deeply grounded in our bodies, although, in Lakoff's account, it does not follow that these primary metaphors are expressed in exactly the same way in all languages; nor is it assumed that cross-cultural variation does not play any role at higher levels of conceptualization. In Lakoff's view, primary metaphors are atomic units that can form the basis for wider systems of contextually determined metaphors. Grady (2005) in the same way emphasizes the universal nature of primary metaphors:

> *Metaphors we live by* pointed to correlation as a basis of conceptual metaphors, and this type of account in terms of recurring correlations between fundamental dimensions of experience is the basis of the theory of 'primary metaphors' (see Grady, 1997a, 1997b, 1999; Lakoff and Johnson, 1999). Like UNFEELING IS COLD, other patterns motivated in this way – e.g., MORE IS UP (e.g., "Bankruptcies have skyrocketed"), FUNCTIONAL IS ERECT (e.g., "The computers are down.") – are not credibly explained as products of spontaneous, online analogical projection. These patterns tend to be cross-linguistic because they are motivated by correlations which are so fundamental and inescapable that they do not vary from culture to culture – no cultural knowledge is required in order to associate temperature and feeling, or weight and difficulty, etc. (Grady 2005, 1600)

The same assumptions about the universality of primary metaphors can also be found in more recent work by Joseph Grady and his collaborators (Grady and Ascoli, 2017):

> Primary metaphors are conceived as associations between fundamental concepts, e.g. defined as concepts that are grounded in universal (rather than culturally determined) aspects of human experience. (Grady and Ascoli 2017, 29)

However, in spite of PMT's claims of universality (but see Johnson 2017, 16 for a non-universalist account of primary metaphors), there is nowadays abundant empirical evidence in favour of cross-cultural or within-culture variation (Alverson, 1994; Rakova, 2002). In Kövecses's view (2010, 204), this tension between universality and cultural variation in conceptual metaphors is the result of two different and concomitant pressures underlying our metaphorical conceptualization: one is the pressure of embodiment that forces metaphorical conceptualization towards its universal characterization; the other is the pressure of context, which is determined by local culture and forces metaphors in the direction of cross-cultural and within-culture variation.

Kövecses (2005) has proposed a solution to account for these different and only apparently incompatible pressures, which he calls the process of *differential experiential focus*. This is based on the idea that our bodily experiences consist of many different components and that, as a consequence, when using the same bodily experience as the source domain of a metaphor, we can single out and emphasize different aspects of that experience, according to the context in which the metaphorical conceptualization takes place. Context is defined by Kövecses (2010, 204) as the set of physical, social, cultural, and discourse aspects, considered in relation to factors such as topic, audience and medium that can also affect the conceptualization of metaphors. I here entertain the suggestion that the process of differential experiential focus may be able to account for the role of context in establishing primary metaphors (in Grady's account), as follows.

Although we all share some physical and subjective experiences, the aspects of these experiences that we focus on to establish a primary metaphorical connection between them depend on the context in which we are embedded. Hence, at this level, the role of context is that of selecting certain aspects of our universally or nearly universal shared experiences (see Kövecses, 2015). The context works as a lens that allows us to isolate some features of primitive universally shared human experiences that occur together often and very early in our lives.

Things are different when we turn to the level of complex metaphors. In this case, the role of context is more pervasive. The combination of elements (primary metaphors, other complex metaphors, beliefs, etc.) that leads us to establish complex metaphors is largely determined by contextual factors. Complex metaphors mostly seem to rely on cultural practices.

Clearly, the issue related to the possibility that the CMT and PMT could account both for the universality and the culture-specificity of metaphorical conceptualization is only a problem we need to address if we consider it as a metaphorical mapping that already takes place at the conceptual level, from concept to concept – from a conceptual representation of the body to another conceptual representation. However, if we take into consideration the first level of embodied metonymic cognition, where the mapping takes place from sensorimotor processes to perception, the issue of the different pressures applied by embodiment and culture has a very different import.

On the one hand, it is true that there are motor activities that are deeply culturally embedded and that these activities, for example the practice of a specific dance or sport, have specific motor programmes underlying them. As such, these motor programmes are culturally determined. In this regard it is interesting to note that the mechanism of Embodied Simulation is sensitive to these cultural differences. If we have never seen someone dancing the capoeira we will likely not have any motor simulation of the observed action or a very low activation of the corresponding motor areas when we finally watch someone dancing it. The motor programmes that implement and underlie these culturally specific practises in our motor system are the product of our learning activity in a specific context.

On the other hand, when we consider the contribution that our body schemas make to cognition, we primarily think of the set of processes and mechanisms that are the precondition of the possibility of any action and learning activity. These mechanisms and processes are innate and universal. Hence, the contribution the body schemas make to cognition is the matrix of universal aspects of human cognition.

3.4 Conclusion

I have proposed that on the basis of the distinction between body schema and body image it is possible to identify two levels of embodiment. The first level is the level of invisible metonymic cognition that is foundational to any possibility of perception and cognition. Embodied metonymic cognition has body schemas as its source domains. The power of embodied metonymic cognition can be explained by its function of structuring our perceptual experiences. The power of this level of embodiment is silent and invisible because in this case our bodily capabilities are the glasses through which we look at the world. The body is not the object of our attention and explicit knowledge. It is, instead, the precondition of the possibility of action and knowledge. In this first case, the contribution of the body to thought and language is direct.

The second level of embodiment is the level of visible metaphors. These metaphors have body images as their source domains. The power of these metaphors can be considered audible and visible, in comparison with the silent and invisible power of embodied metonymic cognition based on the body schemas. In this case our body becomes the object of intentional relations (i.e. bodily experiences, attitudes and beliefs about the body). In this second case the contribution of the body to thought and language is mediated by our cultural, environmentally situated and linguistically structured representations of the body itself. Primary metaphors take place at this level, too.

In this chapter I have presented two different senses of embodiment that are complementary to each other. The first level of embodiment is foundational to any form of perception and cognition and speaks for a direct, non-mediated, role of the physical body in human cognition. The second level is conceptual. Even at this level the body has a foundational role in our conceptual system. In this case, the conceptual representation of sensorimotor experiences becomes the source domain of a metaphorical mapping that allows us to build the conceptual system. However, at this level, the role of the body, being the object of a representation, is inevitably contextually and culturally mediated. Context is always at play at this level, although, as we saw in the preceding section, it affects primary and complex metaphors differently.

Interestingly, the two levels of embodied cognition often interact. The direct physical contribution of the body to cognition can be redeployed in cognitive tasks that imply representations of the body. This is possible thanks to the mechanism of Embodied Simulation, which allows us to directly exploit the physical dimension of the body during cognitive tasks in which we are dealing with conceptual or linguistic representations of the body.

The next chapter will be devoted to a discussion of a recent proposal in the debate on conceptual metaphors: Deliberate Metaphor Theory (henceforth, DMT). DMT was introduced by Steen (2008, 2011) and has had a great impact on the field of metaphor studies. Apart from studying metaphor as a matter of thought and language, Steen also distinguishes a third dimension: metaphor in communication. On this basis, he identifies two different modalities of metaphor processing: deliberate and non-deliberate processing.

Acknowledgment

This chapter is a revised version of Valentina Cuccio "Body-schema and body-image in metaphor processing" in Beate Hampe, (ed.), *Metaphor. Embodied Cognition and Discourse*, © Cambridge University Press 2017 ISBN: 9781107198333, reproduced with permission.

CHAPTER 4

Attention and deliberateness in metaphor processing

4.1 Introduction

Since Lakoff and Johnson (1980), the study of metaphor in language use has concentrated on metaphor's cognitive underpinnings via presumably conventional metaphors in thought. Around the turn of the millennium, this approach was refined by the distinction advanced by Grady (1997a, 1997b) between primary and complex metaphors, the former presumably offering the true cognitive grounding of all metaphor in language and its use. The motivation of a lot of metaphor in language was then argued to depend on the embodied nature of sensori-motor experience, suggesting that complex metaphors such as LIFE IS A JOURNEY would be constrained and composed by distinct and specific configurations of primary metaphors like CHANGE IS MOTION, PURPOSES ARE DESTINATIONS, and so on (see Lakoff and Johnson, 1999). Since then the argument for metaphor as a case of embodied cognition has steadily grown (Gibbs, 2006a; Hampe, 2005).

It is an empirical question, however, how far this embodied view of metaphor reaches into the psychological processes of metaphor comprehension in language use. On the one hand there is evidence suggesting that metaphor comprehension indeed does work by cross-domain mapping that typically starts out from the activation of sensori-motor domains in the brain (see Gibbs, 2011a, 2011b). On the other hand, however, there is evidence suggesting that metaphor comprehension does not work in just one way but includes comparison, categorization, and lexical disambiguation (Gentner and Bowdle, 2008; Giora, 2008; and Glucksberg, 2008). We believe that this issue has not been settled and requires a new model for metaphor that can accommodate all of the evidence: for that purpose Deliberate Metaphor Theory (DMT) has been developed as another refinement as well as extension of CMT (see Steen, 2008, 2011, 2013, 2015, 2017).

We argue that we need to pay closer attention to one crucial level of discourse representation, the one of the situation model as first advanced by Van Dijk and Kintsch (1983). The situation model offers the meaning of an utterance in relation to the projected referents in the world, whether that is a real, imagined, fictional historical or other type of world. We hold that there is a crucial difference between the situation model and another mental model that language users construct during comprehension, the so-called text base, which offers a series of idea units in the form of propositions capturing the conceptual structure of any utterance. The difference between the situation model and text base has been unjustly neglected in CMT: whereas most metaphor may perhaps be seen as involving concepts from two domains in the conceptual text base, we claim that most metaphor is not represented *as* metaphor in the situation model: most metaphor does not involve a picture of the world where two sets of referents are combined in one complex state of affairs, but, on the contrary, most metaphor at the level of reference is just about the target domain. This is precisely the purport of the revolutionary claim in cognitive linguistics that automatically and unconsciously live by metaphors. This can also explain why most people do not experience most metaphor identified in linguistics as metaphorical or somehow special (indirect) in their own language use (Steen 2013, 2015). These regular metaphors may have other interesting properties, which we think can also be accounted for in DMT; yet these properties do not necessarily lead to comprehension by cross-domain mapping, whether driven by embodied cognition or not. This is the basic CMT claim about the power of metaphor in thought that we challenge.

We will use the distinction between situation model and text base to raise new questions about the need for cross-domain mappings in regular metaphor comprehension and suggest that most metaphor comprehension may be handled by lexical disambiguation. If our thesis is true, then the conceptual analysis of metaphor as a cross-domain mapping during utterance comprehension has much less cognitive validity than has been held in cognitive linguistics, for then knowledge of source domains does not generally play a role in the click of comprehension that is reached when a situation model is completed.

We hold that there is one crucial exception to this general trend for metaphor processing, which is deliberate metaphor use: our claim is that deliberate metaphor does require online cross-domain mapping, involving attention to the source domain as a referential domain in its own right. Because of this attention to the source domain in the situation model, which concerns the representation of an utterance in working memory, deliberate metaphor can also be experienced *as* a metaphor by ordinary language users. This is where body images may play a special role in metaphorical utterance comprehension in some of the ways that have been more generally posited for all embodied metaphor by Gibbs and others – an issue we shall return to in the next chapter.

Our overall thesis, therefore, is that the representation of metaphor in situation models is the place where one can or cannot observe the effects of embodied cognition and primary metaphor on metaphor in discourse. We hold that a lot of metaphor does not get represented *as* metaphor in the situation model, that is, with distinct attention to the source domain as a separate referential aspect of the meaning of the utterance. As a result, metaphor then does not have a social function as metaphor very often either: it is not shared between language users in a particular situation as a metaphorical model for some target domain referent or topic simply because it is not available *as* a metaphor to the people interacting by means of it. This can only happen if they revitalize such a metaphor as a metaphor, but this would involve deliberate metaphor use again, including attention to the source domain as a distinct domain of reference from which to (re)consider the target domain. It follows that attention to metaphor is the place where embodied cognition and social interaction can meet, but at the same time we predict that this is not likely to happen very often. The moments when this does happen concern deliberate metaphor use, which consequently becomes an extremely interesting site for testing specific predictions about psychological and social processes of metaphor use.

In the first half of this chapter we will present the main claims of DMT. We will suggest that (a) there is a fundamental difference between deliberate and non-deliberate metaphor use which hinges on attention and (b) that this difference interacts in crucial ways with embodied cognition and with social interaction. In the second half of the chapter we will address the most important implications of DMT for research on CMT, answering to recent challenges by Gibbs (2015, 2017b) that DMT cannot deal with this evidence for CMT. We will suggest in particular that the experimental evidence in favor of CMT can (a) be partly re-interpreted as evidence for DMT and (b) be partly given alternative explanations from the perspective of DMT. This means that the CMT approach to metaphor may be less secure than is held by many while its refinement and extension in DMT leads to interesting new predictions about the diverging behaviour of two groups of metaphor that were not distinguished in previous research, deliberate versus non-deliberate metaphor.

4.2 Deliberate Metaphor Theory

4.2.1 Attention to metaphor

Deliberate metaphor is the kind of metaphor use that requires separate representation of the source domain as part of the referential meaning of the utterance. Examples include explicit comparison (e.g. Shakespeare's 'Shall I compare thee to a summer's day'), simile (e.g., Neil Young's 'You are like a hurricane'), novel *A is B* metaphor ('Science is a glacier'), and extended comparisons, parables, allegories, and so on. Thus, for Shakespeare's famous first line of Sonnet 18, readers must build a meaning for the line which involves the following referents: the speaker, comparing, the addressee, and a summer's day. This meaning hence involves referents coming from two conceptual as well as linguistic domains, the one of a love relationship and the one of summer's days.

Mandatory overt reference to source domains does not hold for non-deliberate metaphor. There people simply represent the meaning of an utterance in terms of referents from the target domain only. This holds for the bulk of all metaphor as discussed in CMT, including for instance the following set of examples for THEORIES ARE BUILDINGS (Kövecses 2010, 6):

> Is that the *foundation* for your theory?
> The theory needs more *support*.
> We need *to construct* a *strong* argument for that.
> We need *to buttress* the theory with *solid* arguments.
> The theory will *stand or fall* on the *strength* of that argument.
> So far we have *put together* only the *framework* of the theory.

Thus, the referential state of affairs that people must construct for the second example would be something like 'The theory needs more help to prove something', all referents in this state of affairs belonging to the target domain of theories.

The distinction between deliberate and non-deliberate metaphor is the cornerstone of DMT. It turns on the issue whether the utterance instructs language users to pay attention to the source domain as a distinct domain of reference (deliberate metaphor) or not (non-deliberate metaphor). This referential meaning of an utterance is fundamentally different than the linguistic and the conceptual meanings of an utterance. These three kinds of utterance meaning have commonly been distinguished in linguistics and can be related to different mental models in discourse psychology (Van Dijk and Kintsch, 1983): when people comprehend utterances, they integrate their meanings into a mental model of the surface text (linguistic meaning), of the text base (conceptual meaning), and of the situation model (referential meaning). However, these three types of utterance meaning as well as their relations to the three types of mental models in discourse processing have not been adequately appreciated in metaphor studies: in CMT, in particular, conceptual and referential meaning have been conflated and are both subsumed under the rubric of 'thought'. Their differentiation is crucial for DMT. A brief illustration will show why. (This will also show that DMT is not a total rejection of CMT but is a refinement and extension.)

For a non-deliberate metaphor like 'The theory needs more support', we may for this moment follow Lakoff and Johnson by saying that there is one metaphor-related word, *support*, coming from the language about buildings (other accounts are possible and possibly even preferable, but that would take us too far afield). This then suggests that in this utterance there may be a cross-domain mapping between theories and buildings. And this is why the linguistic meaning of this utterance in the surface text involves metaphor.

Words activate concepts. The word *support* presumably activates the corresponding concept SUPPORT, which, still according to CMT, comes from the source domain of buildings. This means that the concept designates something that holds or bears physical weight. In the text base the conceptual structure of the proposition corresponding to 'The theory needs more support' looks like this: (NEED THEORY MORE-SUPPORT). The proposition is metaphorical in the text base for the same reason as the sentence in the surface text.

From a discourse point of view, this conceptual structure is essentially incoherent. The proposition is about the target domain of theories but has one concept that is not about theories but about buildings. In order to construct a situation model for this utterance that is coherent and that captures the conventional referential meaning of the utterance, CMT says that we need to do a mapping across the two domains, from the source domain of buildings to the target domain of theories. This then leads to a referential meaning for the utterance that can be described as 'This theory needs more help to prove something'. This referential meaning is the state of affairs that is part of the situation model that addressees construct for this utterance as the current part of the more encompassing and ongoing discourse. As can be seen, its output does not comprise referents from the source domain but only from the target domain.

According to CMT this is the product of an unconscious, automatic process. DMT adds that this is the reason why such metaphors are hard to recognize as metaphorical by regular language users: there is no trace in the situation model in their working memory of the source domain words (surface text) and source domain concepts (text base) – there are only target domain referents. According to CMT, these have been produced by a cross-domain mapping when resolving the conceptual incoherence problem (in the text base) for constructing the referential state of affairs (in the situation model). Except for the differentiation between conceptual and referential mental representations for the text base and the situation model, which are conflated to the conceptual level of 'thought' in CMT, all of this is standard CMT analysis.

Now contrast this to what happens in a deliberate metaphor like 'Shall I compare thee to a summer's day?' The linguistic meaning of this utterance also involves language coming from some other domain than that of the target: 'a summer's day.' The precise nature of the conceptual source domain involved may be left aside here, but it clearly is different than the target domain, which concerns the relationship between two lovers. This is why in CMT the linguistic meaning of this utterance in the surface text is also metaphorical (albeit expressed in the form of an explicit metaphorical comparison).

The conceptual meaning of this utterance is metaphorical by the same token. The words activate corresponding concepts and the resulting conceptual structure of the proposition looks like this: (COMPARE-TO SPEAKER ADDRESSEE SUMMER'S-DAY) (see Kintsch, 1998). The concept of a SUMMER'S DAY derives from another domain than the other concepts, which are part of the target domain. This makes the proposition as part of the text base metaphorical too.

As above, the presence of a concept from some different domain poses a threat to the coherence of the situation model. As above, since this is metaphor, in CMT this is supposed to be resolved by cross-domain mapping. However, what is different here is that this particular utterance includes an explicit instruction for the addressee to integrate the alien concept of summer's day into the encompassing frame of the rest of the utterance. As a result, all of these concepts must be represented as part of the referential meaning too, which reads something like this: 'Shall the speaker compare the addressee to a summer's day?' In other words, this utterance presents a state of affairs that explicitly concerns a comparison between a referent from the target domain, the addressee who is the lover, to a referent from some source domain, 'a summer's day'. This is a referentially mixed state of affairs that should be a component of the developing situation model. The source-domain concept is represented as a distinct referent, belonging to a distinct domain that is to be compared to another referent, and this constitutes the referential meaning of the utterance. The cross-domain mapping involved in metaphor is here not something that presumably takes place between text base and situation model construction, as in our non-deliberate example illustrating the reasoning of CMT; instead, it is something that the utterance explicitly puts on the referential agenda for the addressee who is instructed to represent a comparison between these referents.

This differentiation between these two scenarios for metaphor processing – non-deliberate versus deliberate – is new and, as noted above, constitutes the corner stone of DMT. If we assume from a broadly cognitive-linguistic and pragmatic starting point that all language use is intentional, deliberate metaphor use involves the intentional use of the source domain as a distinct component in the referential meaning of the utterance. From a discourse processing perspective, the latter is part of the developing situation model, which is a mental model that all language users must construct for any utterance. Situation models include representations of the referents that utterances are about and that language users attend to when they comprehend discourse. The content of the situation model is what the sentence is about, is part of working memory, and involves states of affairs that are open for introspection and can be reported in think aloud studies (see Steen, 1994).

The inclusion of the source domain of the deliberate metaphor in the referential structure of the utterance has a special function: it acts as the basis for a non-target perspective on the target referent, from some 'alien' source referent. This means that some metaphors deliberately place source domain elements within the window of attention of addressees so that they indeed experience understanding one thing in terms of something else, whereas most metaphors do not do this. In DMT, the former metaphors are identified as 'deliberate' metaphors and the latter as 'non-deliberate' metaphors. The fact that the source domains of some metaphors emerge in our attention makes them available for social interaction in terms of sharing, uptake, development and criticism; however, this does not hold for the bulk of metaphor, which is non-deliberate. What looks like a metaphor in the structures of discourse then does not have to be used as a metaphor in psychological or social processes of discourse.

4.2.2 Attention to metaphor, embodied cognition and social interaction

Before we can continue with the relation between attention to metaphor and embodied cognition, we should now first re-examine the above sketch of non-deliberate metaphor and interpret it as a sketch of processing. According to CMT all metaphor, and therefore non-deliberate metaphor, too, requires resolution by a cross-domain mapping in the text base before it ends up as a pure target domain referential representation in the situation model. This is certainly a theoretical possibility. However, an alternative is also possible. For most non-deliberate metaphor can cause regular activation of source domain meanings during lexical access for surface text construction, spill over into regular source domain concept activation during text base construction, but then lexical and conceptual disambiguation processes may kick in to suppress the role of the source domain concepts so that simultaneously activated target domain meanings are the only remaining meanings (see Giora, 2008).

To illustrate, the word *support* in our example above might lead to activation of both a building and a theory sense; it might give access to both the corresponding building and theory concepts. But then the irrelevant building concept might get suppressed and the already available theory concept might be retained to project the relevant theory referent in the situation model. What is crucial here is that these target domain referents would not be the product of online cross-domain mapping, presumably caused by the activation of conventional conceptual metaphors like THEORIES ARE BUILDINGS. Instead, they would be the result of lexical disambiguation and suppression processes of already available but situationally irrelevant source domain meanings.

This alternative picture is compatible with experimental research done by for instance Bowdle and Gentner (2005), Giora (2003) and Keysar, Shen, Glucksberg and Horton (2000). For non-deliberate metaphor in language use, it is hence not clear whether metaphor in fact causes online cross domain mappings during referential meaning construction, as is claimed by the strong version of CMT. Instead, it is also possible that non-deliberate metaphor at most briefly activates source domain concepts during text base construction that are then automatically discarded as irrelevant for the referential meaning of the utterance, simply because the required target domain meaning and concept of the non-deliberate metaphor-related word is also, simultaneously, available and active. Why would language users take the more elaborate route of doing a cross-domain mapping every time they come across an already conventional metaphor, for instance from concrete support in buildings to abstract support in arguments, if the intended product of such a mapping – abstract support in buildings – is already there, both in the language and in people's mental dictionaries as well as mental encyclopaedias? Even if some aspects of the activated source domain concepts remain independently active as a result of their prior automatic access, as is suggested by some research (see Giora, 2008), this does not give them the functional role attributed to them by classic CMT in generating relevant cross-domain mappings for establishing the situation model that the utterance is about.

Taking this alternative scenario as a more plausible starting point, DMT proposes a distinction between two roles for embodied cognition in metaphor. For non-deliberate metaphor, as in our *support* example, sensorimotor knowledge would play an automatic role when a polysemous word and concept are accessed and activated, but that sensorimotor knowledge would then lose force and die down when the utterance is represented in the situation model. The stages of surface text and text base construction might then give rise to source-domain related feelings and the like, but these would remain fleeting and unconscious, and they would moreover not play a functional role in the construction of the referential meaning of the utterance, which is crucial for people's experience of the discourse as metaphorical or not. In other words, this alternative analysis of non-deliberate metaphor processing raises the question which precise role such a process of embodied cognition might have to play in the construction and experience of any non-deliberate metaphor.

For deliberate metaphor, as in our Shakespeare example, sensorimotor knowledge would also play an automatic and unconscious role in lexical access and in concept activation but would then continue to be part of the next dimension of meaning construction that is referential. What is more, since the source domain of the summer's day must be represented as a distinct referent in the situation model as well, its basis in embodied cognition would remain alive and become part of the experience of referential meaning of the utterance. This role has been predicated by CMT of all metaphor, but DMT argues that it is only deliberate metaphor which has such a meaning constitutive role in metaphor processing in discourse. The way in which these two routes can be incorporated in current research in embodied simulation will be elaborated in the next chapter.

The consequence of this differentiation of the role of embodied cognition for non-deliberate metaphor versus deliberate metaphor is the following: only for deliberate metaphor is there an effect of the cross-domain mapping on meaning in such a way that it becomes available for social interaction. Since for deliberate metaphor the source domain and its basis in embodied cognition come up in the situation model in working memory, this can be attended to by both sender and receiver. Up-take of the source domain can then occur in various ways, to savor and appreciate the cross-domain mapping, to extend or constrain it, to play with it, or to criticize and resist it. This is when metaphor and its basis in embodied cognition can play a role in social interaction.

In non-deliberate metaphor, by contrast, there may be short-lived cognitive and affective effects of the brief activation of the source domain senses and concepts, but these are at most associations. They do not feed into the construction of the referential representation of the utterance, as described above. Such associations, whether cognitive or affective, may of course be subliminally felt by sensitive language users, but they would not be the inevitable result of some cross-domain mapping that is constructed during processing, as has been claimed by CMT. The latter, we argue, only occurs with deliberate processing.

Our overall thesis, therefore, is that the representation of metaphor as metaphor in situation models is the place where one can observe the effects of on the one hand embodied cognition and primary metaphor on metaphor in discourse, and on the other hand the requirements of social interaction on metaphor as a tool for communication. However, since according to DMT most metaphor does not get represented as metaphor in the situation model, it does not have such a social function as metaphor very often either. As a result, attention to metaphor, and in particular the source domain, in people's working memory may be a place where embodied cognition and social interaction can meet, but at the same time we predict that this is not likely to happen very often since most metaphor use is non-deliberate. The moments when this does happen, in deliberate metaphor use, consequently become an interesting site for careful scrutiny.

4.3 Conceptual Metaphor Theory

Perhaps the most important question about DMT and the way it sees the relation between metaphor in embodied cognition and social interaction is how it relates to CMT. Since CMT is the dominant theory for metaphor, DMT needs to relate to the evidence produced for CMT and show how it can be accounted for. Part of the urgency for showing this is the claim that DMT totally rejects CMT (Gibbs, 2017a). This is a misunderstanding. DMT is an extension of CMT that challenges some of the claims produced in CMT but certainly not all of them (e.g., Steen, 2011, 2015). The central issue for this section is how DMT deals with the experimental evidence in favor of CMT (Gibbs, 2015a).

There are two answers to this question. DMT first of all throws new light on experimental evidence for CMT and shows that some of it is in fact based on deliberate metaphor use. What then looks like evidence for CMT in fact is evidence for DMT, in ways that will be discussed below. Whether that research can then still count as evidence for CMT is a moot point and depends on which claims of CMT are at stake. This is a challange for CMT and not for DMT.

Secondly, other experimental evidence for CMT does not involve deliberate metaphor use, but can be given an alternative explanation that is in line with DMT. Such an alternative view is not necessarily the same as CMT's. DMT in particular gives a new interpretation to the role of metaphor in unconscious metaphor processing, which is held to take place via lexical disambiguation for non-deliberate metaphor. This raises new questions about the encompassing cognitive model for metaphor processing, and these questions also pertain to the account offered in CMT. This, again, is a challenge for CMT, not DMT.

Both of these issues will be elaborated below. Because of the limited space for this chapter, we will focus on the experimental evidence used by Gibbs (2011b) for his positive evaluation of CMT, which he adduced as support for his own challenge to DMT in Gibbs (2015a). We will ask how the studies discussed by Gibbs (2011a) provide experimental evidence that conceptual metaphors *are* recruited during online processing, driving the comprehension of metaphorical utterances. This is the main claim that we have problems with in CMT whereas Gibbs states that there is a huge amount of experimental evidence for this claim in his critique of DMT.

It is interesting to note that there are other places where Gibbs does allow other conclusions to follow from this evidence: he entertains no fewer than four different alternative interpretations of CMT (Gibbs, 1999), one of which is in fact close to what DMT not only argues but also explains. He also proposes, from a dynamic systems theoretical perspective (Gibbs, 2011b), that many different processes may be at play in discourse which allow for different configurations of metaphor processing, crucially also allowing for the emergence of conceptual metaphor as a posthoc result of processing instead of being the driving force in metaphor processing – this is not only completely compatible with DMT but is now also accounted for by DMT. Yet the challenge to DMT regarding the role of the presumably huge amount of evidence for CMT is a fair one and we will address it in this spirit.

The challenge Gibbs raises regarding DMT's view of the experimental evidence for CMT's central claim that metaphor processing in language always recruits cross-domain mappings excludes 13 publications discussed in Gibbs (2011b) that are not experimental but present theory, methods, or other work: Bortfeld and McGlone (2001), Gallese and Lakoff (2005), Gentner and Kurtz (2006), Gibbs (2006a), Gibbs (2006b), Kövecses (2008), Kertész and Rakosi (2009), Mason (2004), McGlone (2007), Murphy (1996), Ruiz de Mendoza and Santibanez (2003), Tendahl and Gibbs (2008), Vervaeke and Kennedy (1996). It also excludes 17 publications in Gibbs (2011b) that do not concern metaphor in language processing: Casasanto and Boroditsky (2008), Forcevillle (2002), Forceville (2005), Giessner and Schubert (2007), Goldwasser (2005), Johnson and Larson (2003), Meier and Robinson (2004), Meier, Robinson, and Clore (2004), Meier, Robinson, Crawford, and Ahlvers (2007), Orton (2004), Schnall, Benton and Harvey (2008), Schubert (2005), Storbeck and Clore (2008), Williams and Bargh (2008a), Williams and Bargh (2008b), and Zong and Liljenquist, (2006). There are another 12 papers in Gibbs's evaluation that do not present experimental but other types of evidence for CMT in language processing: Borbely (2004), Cameron (2007), Coulter, Zaltman and Coulter (2001), Gentner and Grudin (1985), Gibbs and Cameron (2008), Gibbs and Franks (2002), Larson, Nerlich and Wallis (2006), Núñez and Sweetser (2006), Ozcaliskan (2003), Pelosi (2007), Wiseman (2007), and Yu (2003). The remaining eight papers referenced by Gibbs (2011a) are then part of the experimental evidence for CMT and need an analysis from the standpoint of DMT.

4.4 Experimental evidence for Conceptual Metaphor Theory as evidence for Deliberate Metaphor Theory

We will now focus on the experimental studies argued to offer experimental evidence for CMT, suggesting in particular that conceptual metaphors drive the comprehension of metaphor in language use by means of online cross-domain mappings. Many of these studies, upon close scrutiny, are in fact based on deliberate metaphor, and this is precisely what DMT predicts. This means that they utilize metaphors that must be represented as metaphors in the situation model and give rise to attention to the source domain *as* a source domain, which then leads to online cross-domain mapping between source and target referents. We claim that it is this feature which explains their effect as metaphors upon comprehension. It remains to be seen whether the same effects have been obtained for non-deliberate metaphor, which would be surprising in DMT but is the central prediction of CMT.

The strongest line of research for CMT involves online experiments with for instance reading time measurements. Gibbs discusses two such studies, and we can now argue that these involve deliberate metaphor. Pfaff, Gibbs and Johnson (1997) conducted six experiments to show that people's metaphorical conceptualization of a topic influences the appropriateness rating and processing time of conventional and novel euphemisms and dysphemisms, as in the following examples:

> Paragraph primes SEXUAL DESIRE IS A HUNTING ANIMAL
> Dirk is a real wolf. He prowls the singles bars looking for unsuspecting young women to proposition. One night, he saw a particularly tasty-looking morsel in a mini-skirt and said to his friend,
> "*I'm ready to pounce.*"
> "*She's turning my crank.*"
>
> Paragraph primes SEXUAL DESIRE IS AN ACTIVATED MACHINE
> Dirk is a real operator. He cruises the singles bars looking for young women to proposition. One night, he saw a particularly sleek-looking model with all the options and said to is friend,
> "*I'm ready to pounce.*"
> "*She's turning my crank.*"

For the first vignette, the paragraph should increase appropriateness ratings and processing speed of 'I'm ready to pounce' in comparison with 'She's turning my crank', and this should work in the opposite direction for the second paragraph.

From the perspective of DMT, however, these preceding paragraphs depend on deliberate metaphor use: they exhibit a combination of an *A is B* construction in the first sentence with a continuation in at least one striking and novel metaphor in the next sentences. Novel metaphors, including novel *A is B* metaphors, are deliberate because they require online cross-domain mapping to project an unknown target domain referent from a known source domain referent. Conventional *A is B* metaphors are potentially deliberate because they are ambiguous between two readings: one in which the source domain term is interpreted at target domain level, which would make the cross-domain mapping unnecessary and would lead to categorization, and one in which the source domain term is interpreted at source domain level, which would draw attention to the source domain in the situation model (Glucksberg, 2008). The latter reading would result in deliberate metaphor use. The positive findings of Pfaff et al. (1997) for CMT might hence be due to the fact that these linguistic realizations of the underlying conceptual metaphors are deliberate and require a separate representation of the source domain as a distinct referential domain in the situation model.

It should be noted that the article has an appendix with a list of conceptual domains, X-phemisms, and relevant conceptual metaphors in parentheses, but does not give us the experimental materials. This problem also holds for another online study, Gibbs, Bogdonovich, Sykes and Barr (1997), who conducted a priming experiment to test the role of conceptual metaphors in idiom comprehension. It is therefore impossible to determine how representative the above text vignettes are of the stimuli, or to examine how text vignettes were constructed in the Gibbs et al. (1997) study. It is therefore an open issue whether the findings of this study are independent of the role of deliberate metaphor. If the illustrations are representative, they are not.

The reported findings of Pfaff et al. (1997) also invite careful scrutiny:

> One of the puzzling findings of our studies was the failure to replicate the consistency effect for familiar phrases across the different experiments. For instance, the participants in Experiments 3 through 5 found familiar, but inconsistent X-phemisms to be as appropriate and easy to understand as the familiar, consistent phrases. Even though Experiment 6 indicated (similar to Experiments 1 and 2) that familiar-consistent phrases took less time to process than familiar-inconsistent ones, it seems clear that the familiarity of an X-phemistic phrase may have greater impact on people's understanding than metaphoric consistency.

This is precisely what may be expected from a DMT perspective: some of the story contexts may *not* have included deliberate metaphors, which is highly possible for familiar stimuli – in that case, the metaphorical endings may *not* work as metaphors in requiring cross-domain comparisons at the referential level. Then it would only be their coherent or incoherent target-domain ending of the story that may have an effect on the ratings and reading times, as reported by the authors. A careful analysis of the experimental materials might hence lead to new research where the distinction between deliberate and non-deliberate metaphorical paragraphs as well as endings is optimally controlled and manipulated. Until then the jury must remain out whether this study presents evidence for CMT, DMT or both.

In a somewhat similar study, Gong and Ahrens (2007) investigated whether conceptual metaphors were accessed during online processing by examining the effect of different tasks (judgments and reading time) and of different ways of presenting the materials (sentence by sentence or at the end of paragraphs). This study is in effect a combined re-run of Nayak and Gibbs (1990) and Keysar et al. (2000), which led to diverging findings of the effect of conceptual metaphors on reading times and elicited judgments. In their combined study, Gong and Ahrens (2007) do not find a sentence-by-sentence effect but do find a paragraph effect.

The absence of a sentence-by-sentence effect would in fact be consistent with DMT if the metaphors in the stimulus materials are conventional and not deliberate. However, the information in the article does not offer any information about metaphor conventionality or novelty (and obviously not about deliberateness, which was not an issue then). Yet the sample text and the intention of the overall argument suggest that the metaphors should be conventional and non-deliberate. This leads to our provisional conclusion that the first finding is consistent with DMT but not with CMT.

The second finding, that there *is* a metaphor effect at paragraph level, is somewhat harder to understand: if the metaphors do not work as metaphors at a sentence-by-sentence level, how can an effect at the end of these sentences arise all the same? However, this finding is comparable to the effect reported by Pfaff et al. (1997) discussed above: from the perspective of DMT, it raises the suspicion that there may be another factor at play through which the incongruent metaphor is perceived as less appropriate. One possibility is that it is not just metaphorically incongruent but also content-wise incoherent with the structure of the text. Consider the example text offered in translation in the article:

> When you write up a good research proposal, you first have to plan a complete design map. In addition, you have to clearly present the research points, including the literature review, the research questions, the motivation, etc. Then, you have to build up the correct research methods and steps. In this way, the model of your proposal will be complete.
> Terminal targets
> Congruent: So, it is not difficult to construct your own theory.
> Incongruent: So, it is not difficult to promote your own theory.

The use of *promote* in contrast with *construct* is not just metaphorically incongruent, but also makes less sense as a conclusion to the text: theory *construction* follows naturally from the previous actions, whereas theory *promotion* is a new action that is relatively independent and moreover may be difficult in its own right. This could also explain a high incongruence rating.

The study had thirty sets of materials like this, but they are not included in the article. It is hence unclear if the incongruent target sentence also always was structurally incoherent. The above example, however, suggests that this and other factors may have played a role. In conclusion, Gong and Ahrens offer support for one claim of DMT which goes against CMT, that non deliberate conventional metaphor from one sentence to the next does not have an effect on reading, while the evidence is inconclusive about another claim of CMT, that the presence of conventional metaphor in a paragraph may have an effect on reading, which may be explained by the possible presence of a confound.

Offline experimental research advanced by Gibbs (2011b) that may be shown to depend on deliberate metaphor includes work by Read, Cesa, Jones, and Collins (1990) and Robins and Mayer (2000) on how metaphor in text can affect people's reasoning and decision making after they have finished reading. Read et al. (1990) studied metaphor in political rhetoric by examining the effect of four text-initiating metaphors and their associated passages on people's memory as well as on their attitudes. Here are the text-initiating metaphors:

1. Giving loans to Zaire was like offering crates of whiskey to an alcoholic.
2. Passage of the tax bill was like feeding time for the hogs.
3. This investigation into government wrongdoing is run like the Salem Witch Trials.
4. My Congressional opponents are like spoiled children.

All of these metaphors set up explicit analogical cross-domain comparisons that must be represented as such in the situation model. The reader is deliberately instructed by the utterances to set up a cross-domain mapping including a separate role for the source domain as part of the referential meaning of the sentence in each case.

Along similar lines, Robins and Mayer (2000) investigated whether metaphors can have a framing effect in a series of six experiments. For Experiment 1, two vignettes about the international trade dilemma were created that comprised many metaphors which spell out a point by point explicit analogical comparison in an encompassing cross-domain mapping:

> Vignette with *TRADE IS WAR* metaphor frame
> International trade is a war. Tariffs, or trade rules, are barricades that shield the vital interests of countries from harm. Victory is achieved when a country maintains its own safeguards but is able to penetrate the markets of its adversary. The trade deficit means that we are losing ground on the battlefield of the trade war. Tariffs would shield us from such loss and help us reclaim our trade territory.
>
> Vignette with *TRADE IS A TWO-WAY STREET* metaphor frame
> International trade is a two-way street. Tariffs, or trade rules, are obstacles in the road that impede the flow of traffic. Success in trade is achieved by removing all obstacles on both sides of the street allowing the free passages of goods. The trade deficit means that these obstacles are causing stop and go traffic on the roads of trading. Tariffs would prevent us from speeding up again and reaching our trading destination.

The meaning of most of these sentences involves a cross-domain comparison between some referents of trade and some referents of war or traffic. These are deliberately constructed cross-domain mappings that the reader must represent as involving two sets of referents. The same holds for the materials in Experiment 2, where two vignettes on interpersonal relationships were created along the same lines.

For Experiment 3, three vignettes about company culture were developed. They ended with a sentence in three variations that comprise at least two deliberate metaphors: "dedication and loyalty to the organization are most important. We expect our employees to be a family/good soldiers/good citizens." Saying that you expect your employees to be a family or good soldiers sets up an *A is B* structure that requires representation as a cross-domain comparison in the situation model (Bowdle and Gentner, 2005), to the effect that the meaning of the utterance becomes 'employees must behave like a family does/good soldiers do', with a separate referential domain or space in the utterance for 'family' and 'good soldiers'.

For Experiment 4, variations of two differently metaphorically structured texts were employed to study the occurrence of any framing effects:

> Vignette with SAFETY NET metaphor frame and consistent information
> John and Susan are getting married and are deciding whether or not to get the safety net of a prenuptial agreement. A prenuptial agreement is basically a document that explicitly states how a couple's resources would be divided in case of a divorce in the future, thus safeguarding against substantial loss. Because a marriage is risky and unpredictable, such a trapeze act requires having a safety net. John and Susan both think that it's probably a good idea to get a prenuptial agreement because it is difficulty to foresee future events. The responsible thing, they argue, would be to have a safety net just in case something happens.

> Vignette with SAFETY NET metaphor frame and consistent information
> John and Susan are getting married and are deciding whether or not to get the weapon a prenuptial agreement. A prenuptial agreement is basically a document that explicitly states how a couple's resources would be divided in case of a divorce in the future, thus safeguarding against substantial loss. Because a marriage is meant to be a trusting commitment, having a weapon will inevitably lead to a couple using that weapon. John and Susan both think that it's probably a bad idea to get a prenuptial agreement because it promotes negative future events. The responsible thing, they argue, would be not to have that weapon to avoid the problems it would cause.

Both of these frames are deliberately metaphorical, for the following reasons. They comprise the use of a coherent series of metaphors with some strikingly novel expressions (e.g., trapeze act, safety net). Moreover, some clauses are completely metaphorical ('such a trapeze act requires having a safety net'), requiring explicit representation in the situation model *as* a separate referential domain. And finally, the key phrase expressing the key referent from the source domain (safety net, weapon) is repeated no fewer than three times. Experiment 5 uses a similar textual set up with another metaphorical frame, where academic teamwork is compared to football.

Experiment 6 used the following vignettes, with more than one metaphorical expression per source domain, which itself is introduced by the signal for explicit comparison 'seeing X as Y':

> *STRIKE IS A WAR* vignette
> As you may know, many big company employees are currently on strike over some proposed decreases in health benefits. Some commentators see this as an inevitable assault that management wages on workers every once in a while, and are encouraged that workers are appropriately entrenching themselves for the battle to come.

> *STRIKE IS A DANCE* vignette
> As you may know, many big company employees are currently on strike over some proposed decreases in health benefits. Some commentators see this as an inevitable dance that happens between management and the workers every once in a while, and are encouraged that workers are going through the steps.

These studies show comprehension and framing effects of deliberate metaphor. Whether this in fact can also be seen as evidence for CMT depends on the question whether the related conceptual metaphors affect text processing for text versions without any deliberate metaphor and only non-deliberate ones. This would throw an interesting light on how metaphorical frames need to be structured in language in order to have an effect on people's processing (see in press Reijnierse et al., 2015; Steen et al., 2014).

Other offline experimental research also involves the use of deliberate metaphors, such as Allbritton, McKoon and Gerrig (1995), which has a recognition task of sentences and words from text. The stimulus texts, however, are heavily metaphorical in a way that is comparable to the materials discussed for Pfaff et al. (1997) above. Gibbs and Bogdonovich (1999) examine post-hoc reports of mental imagery for metaphor in poetry, but this genre has lots of deliberate metaphor. And McGlone (1996) presents an interpretation task that has numerous novel, and therefore deliberate, metaphors. It looks as if the findings of these studies are mainly due to deliberate metaphor use, supporting DMT.

In sum, both online and offline experimental research presumably offering evidence for CMT, as argued by Gibbs (2011b), can be shown to depend on the presence of deliberate metaphor in the stimuli. The findings of these studies can hence be taken as support for DMT. How these findings can be upheld as evidence for CMT in contradistinction from DMT is a challenge for advocates of that argument.

4.5 Experimental evidence for Conceptual Metaphor Theory and alternative Deliberate Metaphor Theory interpretations

Most of the offline studies discussed by Gibbs (2011a) can be given another, alternative interpretation from the perspective of DMT. In particular, it is quite possible that the conceptual metaphor (or even simply metaphor) affecting the outcomes of for instance a metaphor explanation task arises as a post-comprehension phenomenon of metaphor comprehension. It should be recalled that Gibbs (2011a) has allowed for this possibility himself as well. It is entirely compatible with DMT that conventional metaphors may give rise to representation by comparison again if they are revitalized by their deliberate use as a metaphor, which may happen when they need to be explained. This type of study therefore does not show that metaphors require online cross-domain mapping, as in the strong version of CMT, but instead show that metaphor effects can arise as the result of posthoc deliberate metaphor processing, as is compatible with DMT.

In the following studies, the metaphor that might be non-deliberate in the materials may in fact have been revitalized as a metaphor by the task. This applies to Boers and Littlemore (2000), where participants have to explain conceptual metaphors; to Gibbs (1991), which collects verbal explanation of idioms by children; to Gibbs (1992), which also focuses on intuitions about and ratings of metaphorical idioms in five out of six studies; to Gibbs, Gould and Andric (2006), which focuses on people's reported imaginations of impossible actions; to Gibbs, Lima, and Francuzo (2004), which is based on a questionnaire about people's knowledge about desire as hunger; to Gibbs and O'Brien (1990), which again examines reported images of idioms; to Nayak and Gibbs (1990), which collects offline appropriateness judgments (see the discussion of Gong and Ahrens, 2007 above); and to Siqueira and Gibbs (2007), who carried out a question-answering study about primary metaphors. In all of these cases, it may have been the task that has made the participants focus on the properties of the source domain which then turns the understanding process of the metaphor into a case of deliberate metaphor use. These findings demonstrate the DMT claim that such deliberate metaphor use works and may even be related to conceptual metaphor, which themselves may be locally (re)constructed as a post-hoc cross-domain mapping (see Gibbs, 2011b). But they do not show the strong CMT claim that all metaphor comprehension works via online cross-domain mapping which is activated and used to comprehend an utterance.

Related methodological problems play a role in some of the well-known studies discussed by Gibbs (2011a, 2011b) that examine time as space (Boroditsky, 2000; Boroditsky, 2001; Boroditsky and Ramscar, 2002; Gentner, Imai, and Boroditsky, 2002; McGlone and Harding, 1998; Núñez, Motz, and Teuscher, 2006; Santiago, Lupianez, Perez and Funes, 2007). In varying ways these studies suggest that the comprehension of language about time is comparable to the comprehension of language about space, which is then presumably the driving force behind the comprehension of time. This has been presented as one of the strongest cases for CMT. However, Boroditsky (2000) draws a conclusion that would be entirely compatible with DMT: 'with frequent use, mappings between space and time come to be stored in the domain of time and so thinking about time does not necessarily require access to spatial schemas.' Other claims by Boroditsky (2001) elaborating this position in ways that are more oriented towards CMT are less solid and have been criticized by Chen (2007), who was unable to replicate the findings.

Other results adduced by Gibbs (2011b) that at first glance support CMT are presented by McGlone and Harding (1998) and by Gentner, Imai and Boroditsky (2002). However, these authors also acknowledge that there are methodological problems that may compromise the validity of these studies. For instance, it is noted that the stimuli representing two different temporal perspectives are not just presumable reflections of different underlying conceptual metaphors but also differ regarding their lexico-grammatical structures (e.g. Gentner et al. 2002, 545) – this is a confound that might equally well explain the findings and has been taken by the same researchers as the motivation for doing new studies. Another explicitly acknowledged problem is that both publications make use of a spatial time line for participants to order events on: this may have revitalized the spatial dimension of the cognitive task presumably addressing temporal understanding alone, which may then be seen as another example of a task that elicits deliberate metaphor understanding. This is a problem that also besets the study of Matlock, Ramscar and Boroditsky (2005), who use a drawing task to capture people's understanding of fictive motion sentences.

The solution to methodological complications like the above has been to restrict the linguistic scope of these experiments to a very small set of materials: McGlone and Harding (1998), Gentner et al. (2002) and Boroditsky and Ramscar (2002) limit themselves to study the effect of just a few fairly specific spatio-temporal words in English: *ahead, before, behind,* and *forward.* Apart from the limited representativeness of these terms, new light has more recently been cast on the validity of these space-time studies by Núñez, Motz and Teuscher (2006), who have presented a new, more complex theory of metaphorical models for the conceptualization of time. This suggests that we need to go back to these previous studies and re-analyze the stimulus materials and the predictions that follow from them from this light in order to be able to assess whether previous research can still be said to offer support for CMT based predictions.

All in all, there are methodological properties of or problems with some of the evidence for CMT that can be given new interpretations from the perspective of DMT. The most important issues involve posthoc revitalization of metaphors *as* metaphors in for instance metaphor explanation tasks or online revitalization of space–time metaphors in for instance metaphor comprehension tasks. Both of these problems can be accounted for as compatible with DMT in that they demonstrate how deliberate metaphor processing may affect metaphor comprehension and explanation. In how far these studies may be taken as evidence for CMT in contradistinction from DMT is a challenge for researchers advocating that argument.

4.6 Attention to metaphor: Embodied cognition and social interaction

Most metaphor is not represented *as* metaphor in people's situation models of metaphor-related utterances. Instead, most metaphor gets naturalized to some target-domain representation at the level of referential utterance meaning. This is the claim of Deliberate Metaphor Theory, which explains this phenomenon by pointing at the ways in which metaphor-related utterances do or do not instruct language users to represent the source domain as a distinct referential domain in the situation model. Since the situation model is the window of attention that language users employ when processing discourse, not many metaphors arise as cross-domain mappings in people's attention. They remain unconscious, as has been argued for more than three decades by Conceptual Metaphor Theory. What is now added to this account is the prediction that some metaphors do become available for attention, and that this happens when they are deliberately used as metaphors. As a result, DMT goes against some of the claims formulated by CMT, but does not reject it completely – instead, it should be seen as a refinement of CMT, raising new questions about unconscious and conscious metaphor processing in relation to utterance structures and functions, intentionality, and attention.

In his challenge of DMT, Gibbs (2015a, 2017a) has argued that DMT cannot deal with the huge amount of experimental evidence for CMT. However, both online and offline experimental findings for CMT involve a lot of deliberate metaphor, some of it in the materials and some of it in the tasks. That such metaphorical representations may also be connected with postulated conceptual metaphors is self-evident and not denied by DMT – inasmuch as conceptual metaphors have been established independently in behavioral research and can also be reconstructed as local online reconstructions by language users. To show that these findings also, or still, support the strong version of CMT in contradistinction from DMT requires experimental research without any role of deliberate metaphor, neither in the materials nor in the tasks.

We have of course not been able to discuss all possibly relevant details of all studies mentioned by Gibbs (2011b) in the limited space that is at our disposal here. With the exception of a handful of studies, though, we have included all of these studies in one way or another in the present argument to explain how DMT can deal with the extant evidence for CMT in a critical but constructive manner. We hope that this contribution will therefore assist in advancing the debate over metaphor from different theoretical perspectives.

For now, however, we believe that attention to metaphor is the key issue in the question about the relation between embodied cognition and social interaction. Attention to metaphor is elicited by deliberate metaphor use, and since deliberate metaphor is rather infrequent in most discourse contexts, we submit that this is the moment when embodied cognition and social interaction *can* meet, but will not often do so.

Acknowledgment

Reprinted with slight alteration with permission from Gerard J. Steen, "Attention to Metaphor: Where Embodied Cognition and Social Interaction Can Meet, but May Not Often Do So", pp. 279–296, in Beate Hampe, (ed.), Metaphor. Embodied Cognition and Discourse, © Cambridge University Press 2017 ISBN 9781107198333.

CHAPTER 5

Embodied Simulation and Deliberate Metaphors

5.1 Introduction

In the previous chapter the notion of deliberate metaphor was defined and discussed at length. The main point was that deliberate metaphors may be the only metaphors that give rise to online metaphorical mappings and hence the only metaphors that we process as metaphors. Importantly, deliberateness in metaphor processing depends on the role of attention to the source domain in the situation model. Only when we pay attention to the source domain in the situation model is a metaphor processed as deliberate and is it processed as a metaphor. Attention, then, is a key notion in defining deliberateness.

Attention is also a key notion when it comes to the functioning of the mechanism of Embodied Simulation. This is because attention can modulate the extent and strength of the activation of the mechanism of simulation in ways that will be further discussed in the rest of this chapter. The notion of attention is, thus, the bridge that links deliberateness in metaphor processing and Embodied Simulation. The recognition of the role of attention in metaphor processing also marks a clear divide between CMT and DMT, since the activation of conceptual metaphors is considered to be automatic in the former approach while in DMT, at least at the level of communication, this is not so. In this regard, it is worth remembering that according to Jonides (1981) automatic processes are those processes that take place mandatorily and without any involvement of attention.

In this chapter I will provide an explanation of the role that attention to the source domain can play in modulating the activation of Embodied Simulation during deliberate processing of metaphors. On this basis, I will develop a new model of metaphor processing that puts together, via the notion of attention, the mechanism of simulation in the new account proposed here (ESN and ESB; see Chapter 1), bodily sensations (or body images – see Chapter 3) and the notion of deliberateness (see Chapter 4).

In this model, ESB is not always recruited during metaphor processing. Only deliberate metaphors recruit this mechanism in all its complexity. On the basis of this model, the following two hypotheses will be proposed and discussed:

- early somatotopic[1] activation (ESN) during conventional metaphor comprehension is a function of polysemous lexical access and early concept activation, irrespective of metaphor type. The activation of ESN is automatic and does not trigger ESB. Bodily sensations (body images) are not involved.
- late somatotopic activation (ESB) during metaphor comprehension is a function of metaphor deliberateness and its role in utterance comprehension. ESN triggers ESB. The latter determines the experience of bodily sensations (body images).

In this chapter I will first discuss the interaction between attention and language with the aim of providing a clear framework for how the former modulates the processing of language. Then I will address the issue of attention in relation to the mechanism of Embodied Simulation, mainly from the perspective of neuroscience. The aim of this section will be, again, to show how attention affects the extent and strength of the activation of Embodied Simulation. In the last section of the chapter, relying on the previous discussion, I will develop a unified account of the role of Embodied Simulation in deliberate metaphor processing. The notion of attention will be key to understanding the specific role played by Embodied Simulation in metaphor understanding when metaphors are processed deliberately as metaphors.

5.2 Language and attention

The interaction between language and attention is a topic that, historically, has been characterized in very different ways. These differences mainly depend on the divergent concepts of language held by different researchers. Mishra (2015b) has addressed this topic from both a historical and a theoretical perspective, providing a comprehensive and up-to-date review of this subject. As is clear from his historical reconstruction of the problem, in a very influential tradition like Chomskyan linguistics, language was and still is considered to be independent of other cognitive systems and mechanisms, attention being one among these. The

1. The motor system in the cerebral cortex has a somatotopic organization. This means that there is a one-to-one correspondence between parts of the body and areas of the brain. Each area of the body is controlled by a specific area of the brain. For example, in the motor cortex we can identify hand areas, foot areas, etc.

ideal speaker-listener was described by Chomsky as being unaffected by possible shifts of attention:

> […] ideal speaker-listener in a completely homogeneous speech-community, who knows its language perfectly and is unaffected by such grammatically irrelevant conditions as memory limitations, distractions, shifts of attention and interest, and errors (random or characteristic) in applying his knowledge of this language in actual performance. (Chomsky 1965, 3)

However, as Mishra (2015a, 1) points out, today we have at our disposal a huge amount of empirical data from different disciplines suggesting that hypotheses such as that advanced by Noam Chomsky can no longer be considered to be true or, at least, cannot be seen as entirely true. We need to be more cautious in the discussion of this topic.

Empirical research on this issue suggests that attention affects language at different levels. Many empirical studies in psycholinguistics, cognitive psychology and even in neuroscience have confirmed this idea (Mishra 2015a, 2015b). Attention affects language to the extent that even the structure of language seems to be shaped by this mechanism, as well as by other cognitive systems. Reflections on the tight relationship between language and attention have been put forward by different scholars and are grounded, for example, in the observation that what is at the centre of our attention often becomes the grammatical subject of our sentences (Wallace, 1982; Ibbotson et al., 2013). Leonard Talmy (1988, 2000) has provided an encompassing and detailed framework of the relationship between language, on the one hand, and attention and other cognitive systems, on the other.

According to Talmy (1988), the figure-ground organization of visual perception and attention, first described by Gestalt psychologists (Kohler, 1969), seems to have modelled the organization of attentional structures in language, too. It is certainly fair to say that Talmy's proposal, as well as other accounts of language developed in the paradigm of Cognitive Linguistics (e.g., Langacker 1987, 1991), has offered a new basis for understanding the faculty of language in ways that are at odds with nativist and modular views of language and cognition such as those proposed by Chomsky (1965), Fodor (1983) and all the scholars working in mainstream classical computational cognitive science. From the Cognitive Linguistics perspective, language, like other cognitive systems, is not informationally encapsulated in innate modules. Language is deeply grounded in perception, attention and memory. It follows that universal aspects in human language are likely to be dependent on universal cognitive structures and mechanisms such as, indeed, attention and vision. Hence, from this perspective, universal, or nearly universal, features of language are not the result of an innate and universal grammar (Cuccio, 2008; Evans and Green, 2006), as Chomsky originally proposed (Chomsky, 1965).

They are, instead, determined by non-linguistic cognitive structures universally shared by humans. This hypothesis is currently one of the best-reputed alternatives to Chomskyan nativism and has inevitably given rise to a different idea of the interaction between language and attention from that proposed by Chomskyan linguists.

A complete historical reconstruction of this topic goes far beyond present interests and I will not push any further in this direction. I will, instead, turn to the discussion of some of the more relevant data currently available in the debate. When we approach the analysis of empirical data, we are forced to admit that the picture that emerges is less clear than we could have hoped. In fact, in the past few years, different hypotheses have been experimentally investigated and the results have not always been consistent. On the one hand, some experimental data seem to support the hypothesis of the automaticity, and hence unattended nature, of language processing (e.g. Maidhof and Koelsch 2011; Pulvermüller et al., 2008; Shtyrov et al. 2012), in accordance with the Chomskyan proposal; on the other hand, further experimental findings have suggested that memory and attention do play a role in the processing of linguistic stimuli (e.g. Waters et al., 2003), in agreement with hypotheses favouring a non-modular and cognitively grounded nature for the faculty of language. But the heterogeneity of these findings can be interpreted as a sign of complexity.

Indeed, the interaction between language and attention is certainly complex and needs to be analysed at different levels and phases. Language comprehension is a process that unfolds in time and its interaction with attention can vary according to the temporal phase of the process of comprehension that is being observed or the kind of task that participants of these studies are being asked to perform. In this regard, it is important to point out that studies carried out on this topic in the recent past have differed in many respects, which considerably complicates the task of directly comparing them and understanding the real import of their empirical findings. Taken together, however, these studies speak for the multifaceted and complex nature of the interaction between language and attention. Different subprocesses of language processing involve different attentional demands. Reading and speaking, for example, are different linguistic tasks that involve attention in different ways. In the same vein, attentional involvement can be different in syntactic as against semantic processing. In what follows I will attempt to create a coherent picture of this situation inasmuch as it is relevant to understanding the interaction between Embodied Simulation and metaphor processing.

In general terms, as is pointed out by Mishra (2015a, 101), the empirical results found by many scholars seem to support the claim that early syntactic activation should be automatic (e.g., Salverda and Altmann, 2011; Singh and Mishra, 2013, 2015; Pulvermüller et al., 2008). This means that attention is not necessarily involved in processing the syntactic structures of sentences, since automatic processes do not imply any involvement of attention (Jonides, 1981).

At the same time, while empirical data seem to support the hypothesis of automatic parsing of syntactic elements, it has been suggested (Friederici, 2011) that semantic processing is not automatic. This means that, in language comprehension, we could automatically process syntactic elements while semantic components could require attention. It is worth noting that Mishra (2015a, 101), in concluding his review of studies on the role of attention in sentence comprehension, warns us that scholars in attention research hardly agree on whether there could be cognitive processes that do not require attention at all. As a consequence, the only guaranteed conclusion that we can draw from available knowledge is that “some aspects of sentence processing seem to proceed without explicit allocation of attention while some other aspects require attention” (Mishra 2015, 101).

On the basis of these considerations on the multifaceted nature of the interaction between language and attention, to comprehend how attention is involved in the processing of language we need a model of language processing that includes the time course of this process and that takes into account the different subprocesses it implies. Angela Friederici (2011) has developed a state-of-the-art model of the syntactic and semantic processes that occur during sentence comprehension and identified their time-course. Attempts to describe this process have led to the identification of subprocesses arising, presumably, in three different temporal phases (Friederici 2011, 1377). This three-phase model of language comprehension and its time-course was developed thanks to electrophysiological studies, based on the measurement of different language-relevant event-related brain potentials (ERP; Friederici, 2002). ERP “are very small voltages generated in the brain structures in response to specific events or stimuli” (Sur and Sinha 2009, 70).

According to this model, the first phase in language comprehension occurs between 120 and 200 ms after the stimulus onset and is considered to reflect early syntactic processes related to the representation of the structure of the sentence. In this first phase, we identify the syntactic categories of words and we build the structures of sentences. A second phase takes place between 300 and 500 ms and seems to reflect both the processing of semantic features and the syntactic features necessary for the assignment of thematic relations. A third phase follows and is considered to reflect late syntactic processes. This phase has been characterized by Friederici (2011, 1382) as the place where syntactic reanalysis and repair take place.

According to this three-phase model of language comprehension (Friederici, 2002, 2011), it is possible to relate different components in the event-related brain potential to different processes and phases of language understanding. In the words of Angela Friederici, the three-phase model can be sketched as follows:

> In the last decades, different language-relevant event-related brain potential (ERP) components have been identified: an early left anterior negativity (ELAN) between 120 and 200 ms, taken to reflect initial syntactic structure building processes; a centroparietal negativity between 300 and 500 ms (N400), reflecting semantic processes; and a late centroparietal positivity (P600), taken to reflect late syntactic processes. Moreover, in the time window between 300 and 500 ms, a left anterior negativity (LAN) was observed to syntactic features that mark the grammatical relation between arguments and verb, and this was taken to reflect the assignment of thematic relations (who did what to whom).
>
> (Friederici 2011, 1377)

Importantly, in relation to the issue of the interaction between language and attention, Friederici (2011; Hahne and Friederici, 1999, 2002) has repeatedly suggested that the early syntactic processing that takes place in the first stage of the three-phase model of language processing is highly automatic and independent of attentional processes and task demands. By contrast, processes occurring in the other phases are not considered to be automatic. Clearly, as has already been suggested, this model proposes a dichotomy between the automaticity of early syntactic processing involved in sentence structure building and non-automatic semantic processes taking place at later stages.

Carapezza and Cuccio (2018) have recently developed a model of linguistic inferences with the aim to provide the tools to account for the different inferential demands entailed by different levels of the process of language comprehension. In this model, the comprehension of language, from the perception of words to the understanding of conversational implicatures, is always considered to be inferential. The Carapezza and Cuccio model is compatible with the three-phase model proposed by Friederici and allows us to also account for pragmatic aspects of language comprehension. In the model, inferences underpinning language comprehension can be either conscious or unconscious.[2] Unconscious inferences are carried out quickly and effortlessly.

Two types of unconscious inferences have been identified in this model: personal and subpersonal unconscious inferences. Subpersonal unconscious inferences are always and unavoidably carried out below the threshold of consciousness. They can never be consciously attended to. This is the case for the inferences underlying the perception of language: they have sounds as inputs and produce words as output. Personal-level unconscious inferences are carried out quickly and effortlessly, too. However, they can be consciously accessed *ex post*, for example if we detect some incongruence in the outcome of the inferential path. In this case,

2. For the definition of consciousness I refer here to Block (2005)'s notion of phenomenal consciousness. See Chapter 3, this volume, for a discussion.

by going back to part of the data and introspect, we are able to reconstruct the inferential steps that have led to the problem in the interpretative process.

Personal-level unconscious inferences underpin both primary and secondary pragmatic processes (Recanati, 2004). Primary pragmatic processes have a string of words as input and produce a proposition as output. For example, in a sentence like "She is smaller than John's sister", as Recanati (2004, 23) has suggested, we must be able to determine who the speaker is referring to with the pronoun 'she'. In this and similar examples, which go from a string of words to a proposition, the inference is carried out unconsciously and automatically. But, as suggested before, it can be accessed *ex post*, if needed.

As for secondary pragmatic processes, these have a proposition as input and conversational implicatures of that proposition as output. For instance, if John asks to Mary if she would like to go to the cinema and she replies: "I have an exam tomorrow morning", he will easily infer the conversational implicature: "Mary will not come to the cinema with me tonight". In this case, the input is a proposition, the output is a conversational implicature and the inferential path that leads from the former to the latter is carried out automatically but can be consciously accessed *ex post*.

In contradistinction to unconscious inferences, conscious ones are slow, cognitively demanding and always involve attention. Conscious inferences can underpin both primary and secondary pragmatic processes. In the former case, as we have seen, the interpretative process takes as its input a string of words and as its output a proposition. Novel metaphors might be good examples of conscious inferences underlying primary pragmatic processes. In the case of secondary pragmatic processes, the starting point of the inferential path is a proposition that needs to be interpreted. Jokes are good examples of secondary pragmatic processes involving conscious inferences. Imagine two friends, Paul and Albert, who are talking about a third friend, John, who had a car accident. Paul says to Albert: "The accident left his face completely disfigured but the doctor said that after surgery he will look exactly like he looked before" and Albert replies: "Oh, that's terrible!". This reply implies two different and incompatible interpretative options. It may be terrible that John will look like he did before because, as Paul and Albert know, he was definitely not good-looking or it may be that the consequences of a car accident (having one's face disfigured and undergoing surgery) are considered to be terrible (see Ferraresi 1983, 73 for a discussion of this example). Both of these interpretations are plausible and probably both are consciously evaluated during this linguistic exchange; this evaluation will lead to the selection of the more appropriate one (or will not, because in the case of jokes, it is exactly the simultaneous presence of two antithetical readings that makes them funny).

In the case of jokes such as the previous one and, generally speaking, when it is particularly problematic to draw conversational implicatures, because different interpretative options are available, all of them being plausible, we need to select the most appropriate one from the range of all possible interpretations. In this case, it is a conscious inference that takes place. We overtly compare different solutions in order to grasp the meaning intended by our interlocutor.

Subpersonal unconscious inferences are here considered to take place in the first phase of Friederici's (2011) three-phase model. Personal-level unconscious inferences take place in the second phase, while conscious inferences occur in the third and last phase of this model.

The three-phase model proposed by Friederici (2011) is interesting in relation to what is one of the central topics of this book, i.e., the attention paid to the source domain of metaphors when these are processed deliberately. Clearly, in Friederici's model there is plenty of room to explain the phenomenon of the deliberate processing of metaphor by having recourse to the notion of attention. To make clear how Friederici's three-phase model of language comprehension fits into the present account of the deliberate processing of metaphors, I need to go a step further in my characterization of the second phase of the model.

According to Friederici's model, the second stage in sentence processing is devoted to accessing semantic knowledge. At this stage, difficulties in semantic integration can occur resulting from lexical disambiguation and hence involving attentional demands. This consideration is extensively supported by previous empirical research that has shown that resolving lexical ambiguity requires increased cognitive control and attention as compared to the comprehension of unambiguous words (e.g., Gernsbacher and Faust, 1991; Gernsbacher and Robertson, 1995; Miyake et al., 1994; Wagner and Gunter, 2004). The resolution of these problems is not an automatic process and, as such, involves attentional demands.

During sentence processing, difficulties due to semantic integration are signalled by an increase of the N400 component. The N400 is an electrophysiological measure that assesses changes in electrical brain activity during and after the presentation of a stimulus. It peaks around 400 ms after the stimulus onset (see Kutas and Federmeir, 2011 for a discussion).

> The N400 is interpreted as reflecting difficulty of lexical semantic integration, as its amplitude is known to increase (*1*) when a word does not have a lexical status (i.e., a non-word or a pseudoword); (*2*) when the second word of a word pair does not fit the first word semantically, and in a sentence (*3*) when the selectional restriction of verb-argument relations is violated; (*4*) when a word does not fit the preceding sentence context with respect to world knowledge or is, moreover, simply unexpected; and (*5*) its amplitude is known to decrease for words as the sentence unrolls due to increased predictability of the upcoming word. Thus the

> N400 is an indicator of (*1*) lexical processes, (*2*) lexical-semantic processes, (*3*) semantic contextual predictability, and (*4*) predictability due to world knowledge. Therefore, it reflects processes relevant to language comprehension at different levels, but not only those that are language internal but also those that concern world knowledge (Hagoort, Hald, Bastiaansen, Petersson, 2004).
>
> (Friederici 2011, 1380)

The comprehension of a deliberate metaphor clearly raises the problems of semantic integration described by Friederici in the previous passage. In the SCIENCE IS A GLACIER metaphor, for example, we need a separate representation of the GLACIER conceptual domain in the referential meaning of the utterance (see Chapter 4, this volume, for a discussion of this example). In terms of the time course and subprocesses involved in deliberate metaphor processing, this means that attention is expected to be paid to the source domain of metaphors (the GLACIER, in this example) in the situation model around 300 ms after stimulus onset. This is because the processes enabling semantic integration and, hence, disambiguation of ambiguous expressions, take place in this time–space. With regard to the mechanism of simulation, after a first automatic activation occurring around 200 ms after stimulus onset (ESN), the activation of Embodied Simulation in its full length (ESB), amplified by the attention paid to the semantic task, should also be observed 300 ms after stimulus onset.

In consistency with this interpretation, and as already anticipated at the beginning of this chapter, in relation to the activation of ESN occurring during non-deliberate metaphor processing, the occurrence of early somatotopic activation before 300 ms can be regarded as a function of polysemous lexical access and early concept activation, irrespective of metaphor type. This means that early somatotopic activation observed around 200 ms after stimulus onset during the processing of non-deliberate metaphors is the result of the automatic and fast activation of concepts related to polysemous words. However, this activation cannot be regarded as a counterargument against the distinction proposed here between deliberate and non-deliberate metaphors. In fact, in itself it does not signal that both the source and the target domains of the metaphors are activated during semantic processing that takes place in the second stage of the process of sentence comprehension. Hence, early somatotopic activation (ESN) does not reveal that a metaphorical mapping takes place in the processing of metaphors. This early activation during the processing of metaphors, irrespective of metaphor type, is indeed predicted by the present model of metaphor processing.

As for the processing of deliberate metaphors, it is here hypothesized that attention modulates the extent and strength of activation of Embodied Simulation. This means that attention paid to the source domain of the metaphor in the second phase of Friederici (2011) three-phase model might trigger a broader involvement of this mechanism (ESB) and the arousal of body sensations (body images).

Indirect support for this claim comes from theoretical and empirical research been carried out with regard to the processing of metaphors as a function of their familiarity. Although deliberate metaphors are not equivalent to unfamiliar metaphors, since the former category is more rich and complex than the second, unfamiliar metaphors are certainly processed deliberately (see Bowdle and Gentner, 2005).[3] As a consequence, results from studies on the processing of familiar and unfamiliar metaphors can give us valuable hints as we develop a model of deliberate metaphor processing.

Interestingly, in connection with the distinction between familiar and unfamiliar metaphors and the different cognitive demands they imply, it is important to note that, while there is no general agreement in the current debate on the characterization of the process of metaphor comprehension (for different interpretations of this process see Bowdle and Gentner, 2005; Glucksberg, 2001, 2003; Kintsch, 2000, 2001; Kintsch and Bowles, 2002), it is widely accepted that the degree of familiarity of metaphors affects the process of understanding. Familiar metaphors are understood faster, more accurately and more easily than unfamiliar metaphors, whose meaning has to be constructed on the spot (Blasko and Briihl, 1997; Blasko and Connine, 1993; Goldstein et al., 2012; Lai and Curran, 2013; Mashal, 2013; Mashal and Faust, 2009). The picture that emerges from these data is consistent and compatible with the hypothesis that only deliberate metaphors require the construction of a metaphorical mapping. Deliberate metaphors are either those metaphors that are highly unfamiliar and novel or they are conventional and sometimes even dead but have been revitalized through particular uses. Only these metaphors make strong attentional demands. By contrast, the meaning of conventional metaphors can be retrieved directly from our memory without any cognitive effort. Since their meaning is directly stored in memory, conventional metaphors usually do not imply the construction of a metaphorical mapping any more. In other words, conventional metaphors, if they are not used deliberately, do not force us to pay attention to both the source and the target domain any more, as we do when we need to build a metaphorical mapping. Conventional metaphors directly recruit a conventional meaning from our memory.

The topic of attentional demands during the processing of metaphors has been addressed in an empirical study (Columbus et al., 2014). The authors of this study did not deal explicitly with deliberate metaphors but took into account as a

3. Although for present purposes I will not use this distinction, it is worth noting that there is a difference between familiar and unfamiliar Metaphors, on the one hand, and conventional and novel Metaphors, on the other. These two pairs of terms will be used here interchangeably.

variable in their empirical work the degree of familiarity of metaphors. As the authors acknowledge (Columbus et al. 2014, 1), the degree of novelty of a metaphor determines the kind of processing the metaphor undergoes. When people face the task of understanding a novel metaphor (e.g. *The textbooks snored on the desk*; Columbus et al., 2014, 1), to be able to understand it they must create a new meaning on-line, through the construction of a mapping from the source to the target domain. By contrast, conventional metaphors (e.g. *The students grasped the concept*; Columbus et al., 2014, 1) can be understood by retrieving previously known metaphorical meanings from memory. Differences in metaphor processing related to the degree of familiarity, the authors continue, affect the involvement of general cognitive capacities such as executive control and hence the degree of attention required by the comprehension of language. All of this is compatible with DMT.

In their study, Columbus et al. (2014) examined whether individual differences in executive control relate to metaphor processing by using eye-movement measures of reading. The relationship between executive functions and metaphor processing was considered to be a function of metaphor familiarity. Findings from this study may be very interesting for the aim of understanding the mechanisms involved in deliberate metaphor processing. Novel metaphors are certainly deliberate, although they are not the only possible kind of deliberate metaphors. It follows that conclusions drawn from the processing of novel metaphors are in all respects conclusions on deliberate processing of metaphors.

In Columbus et al. (2014)'s study, participants performed a reading task while their eye movements were recorded using the eye-tracking technique. They read literal and metaphorical sentences on a computer screen. The metaphorical sentences were either novel or highly familiar. Furthermore, all the sentences were presented in two conditions: in the first condition the sentences contained an adjective that provided contextual information that disambiguated the following topic noun. In the second condition no contextual information was provided (*The textbook snored on the desk at the end of the day; The sailor snored in the hammock at the end of the day; The unopened textbooks snored on the desk at the end of the day; The tired sailor snored in the hammock at the end of the day*).

The findings of this study showed that the reading times of metaphorically used verbs were modulated by familiarity. Indeed, a significant facilitative effect was found for familiar metaphors with reading times generally being faster for familiar metaphorically used verbs as compared to novel metaphorically used verbs. This facilitative effect did not interact with context conditions (presence or absence of prior contextual information) or with individual differences in executive control.

According to the authors (Columbus et al. 2014, 10), this suggests that when people read or listen to novel, unfamiliar, metaphors the process of comprehension is slowed down as an effect of the difficulty they encounter in the task, which thereby becomes cognitively more demanding. In fact, with novel metaphors, people first access the literal sense of metaphorically used words. However, these literal meanings are incongruous with respect to the rest of the sentence. After the incongruity is detected, metaphorical senses are generated by means of a mapping from the source to the target domain of the metaphors. This requires cognitive effort, and especially attention, and likely happens in the second stage of the three-stage model for sentence comprehension developed by Friederici (2011).

These results clearly support the claim that novel, and hence deliberate, metaphors do entail that attention is paid to the source domain, as a result of a process of semantic integration. Semantic integration takes place in the second phase of the three-phase model for sentence comprehension previously described. In agreement with the hypotheses proposed at the beginning of this chapter, conventional and familiar metaphors, if they are used non deliberately, do not involve high cognitive demands due to semantic integration and, hence, are processed faster. Nevertheless, during the comprehension of familiar, conventional, metaphors, in the first phase of processing when we automatically build the syntactic structure of the sentence, it is very likely that a first retrieval of automatic lexical knowledge takes place and this leads to early somatotopic activation in our brain, i.e. to the activation of ESN.

Many empirical studies have shown early somatotopic activation during the comprehension of familiar metaphors. As we have seen (see Chapter 1, this volume, for a review), this means that listening to the sentence “John grasps the idea” determines, at a very early stage of sentence processing, around 200 ms after stimulus onset, the activation of hand-related areas of the motor cortex even if we are not carrying out any hand-related action. However, for familiar metaphors, the meaning of metaphorically used words is then quickly recruited from memory without any need for attention and without any other cognitive demands for semantic integration, as is proved by faster reading times (Columbus et al., 2014). Hence, early somatotopic activation (ESN) during the processing of familiar, conventional, metaphor cannot be regarded as an argument in support of the hypothesis that we always comprehend metaphors as metaphors, i.e.. by means of a mapping from the source to the target domain. In many cases, the majority of cases in fact, this presumably does not happen any more. We do not access semantic information for both the source and the target domain, as it is suggested by the fact that, after early somatotopic activation (ESN), no broader involvement of the mechanism of simulation (ESB) follows.

The next step in supporting this model of deliberate metaphor processing is to see how precisely the mechanism of Embodied Simulation intervenes in this process at later stages, as a result of attention being paid to the source domain and cognitive efforts being devoted to the task of semantic integration. To this purpose, in the following section, it will be shown how attention can modulate the activation of Embodied Simulation to the extent that the involvement of this mechanism (ESN and ESB) will be affected by task-related attentional demands.

5.3 Embodied Simulation and attention

The interaction between Embodied Simulation and attention during language comprehension is a topic that, to the best of my knowledge, has not been directly investigated so far. Hence, since we do not have empirical data at our disposal on the possible modulation of Embodied Simulation by cognitive demands due to deliberate processing of metaphors, in this section I will discuss empirical findings on the interaction between attention and the mechanism of simulation during the observation of action. The goal of this section is to show that Embodied Simulation can be modulated by attention. To pay attention to the cognitive task by which Embodied Simulation is activated enhances the degree of activation of this mechanism, thus leading to a wider involvement of other brain structures in the process of simulation (ESB), as described in the first chapter of this book. If the interaction between Embodied Simulation and attention can be shown to exist during action observation, we can then also formulate suggestions on a possible interaction of these mechanisms during other cognitive tasks, language comprehension among them.

The mechanism of simulation, especially during the direct observation of other people's actions, has usually been characterized in terms of an automatic translation of visual stimuli into motor knowledge (see Chapter 1). Studies on Embodied Simulation usually do not require participants to pay any explicit attention to the action properties of the visual stimulus. Participants are required to watch a computer screen and passively observe actions carried out by other people. If they are instructed to perform any tasks, these are usually not related to the properties of the observed actions and, thus, do not require participants to explicitly attend to the action properties of the visual stimuli.

However, in the last few years, the automaticity of Embodied Simulation has been theoretically and empirically investigated in several studies (e.g., Schuch et al., 2010). As an increasing amount of experimental research has shown, Embodied Simulation does seem to be contextually modulated (Cuccio et al., 2014). Contextual effects on Embodied Simulation have been assessed during action observation by means of fMRI research (e.g. Iacoboni et al., 2005) and during linguistic comprehension by means of behavioural (Cuccio et al., 2014; Lebois et al., 2015; van Dam et al. 2010) and fMRI studies (e.g. Papeo et al., 2012). Using different experimental techniques and distinct experimental stimuli, all these studies have suggested that Embodied Simulation is not automatically and uniformly activated. The arousal and degree of involvement of this mechanism is also a function of the particular task being carried out and of contextual factors. The role played by contextual information in modulating the activation of the mechanism of simulation is in itself sufficient to force us to rethink the claim that the mechanism of Embodied Simulation works automatically. The automaticity of this mechanism cannot be taken for granted and it needs to be, at least, reconsidered.

Recently, the topic of the interaction between attention and Embodied Simulation has been addressed in several behavioural studies that have shown that the activation of the mechanism of simulation varies depending on the attention that participants in the studies are instructed to explicitly pay to the action features of the observed stimuli (Bach et al. 2007; Tipper et al., 2006; Vainio et al., 2007). In these studies, the interaction between attention and simulation was investigated by measuring the compatibility effects between the action properties of observed objects and performed actions. Compatibility effects between an observed action or an action property of an observed object and a performed action are found when the action to be performed is compatible with the motor simulation probably activated by the visual stimulus. This compatibility leads to a facilitative effect, due to a pre-activation of the motor system, determined by motor simulation and reflected by faster reaction times in action performance. Thus, in Tipper et al.'s study (2006), a compatibility effect was found only when the participants attended to an action-relevant feature of an observed object (a door handle). Analogously, Bach et al. (2007) found compatibility effects between observed actions and performed actions only when the participants were instructed to pay attention to the action-related body site of the observed action (Bach et al., 2007). Results of these studies suggest that the attention paid to the action features of an observed stimulus modulates the activation of the mechanism of simulation.

However, these studies are in some respects problematic, as has been recently pointed out by Schuch et al. (2010, 236). On the one hand, these empirical studies provide us with evidence of the interaction between attention and Embodied Simulation, showing that the attention paid to different characteristics of the actions that we observe can modulate the degree of automaticity of the recruitment of Embodied Simulation. On the other hand, they require overt responses to the stimuli and this is clearly a limitation. Indeed, overt responses very likely interact with the motor simulation triggered by the visual stimuli (Humphreys and Riddoch, 2001; Symes et al., 2008). To overcome this limitation, Schuch et al. (2010) carried out an electroencephalography study (EEG) to measure motor system activation and its potential interaction with attention during action observation and, importantly, in the absence of any overt action.

Relying on previous experimental research carried out with EEG and magnetoencephalography (MEG) techniques, Schuch et al. (2010, 236) assessed oscillatory activities of the cortex during the observation of actions. Specifically, they assessed the mu rhythm that is one oscillatory activity that can be observed in the sensorimotor cortex. The mu rhythm is modulated by both action execution and action performance (Pineda, 2005) because its frequency changes in response to the real performance of an action or to the observation of actions carried out by others. The mu rhythm indicates downstream activity of the mirror system (Schuch et al. 2010, 236). It is high in the absence of movement while it is suppressed during both overt movement production and action observation (Cochin et al., 1999; Gastaut and Bert, 1954; Hari et al., 1998; Kessler et al., 2006; Kilner et al., 2006; Muthukumaraswamy et al., 2004; Muthukumaraswamy and Johnson, 2004; Neuper et al., 2009; Nishitani and Hari, 2000; Oberman et al., 2008; Pineda and Hecht, 2009; Ulloa and Pineda, 2007). The assessment of the mu rhythm is, then, a measure of the activation of the sensorimotor cortex during action observation. Suppression of the mu rhythm during action observation indicates that the motor system is activated even in the absence of an overt action. It follows that suppression of the mu rhythm signals the activation of the mechanism of Embodied Simulation.

To understand the experimental design of Schuch et al. (2010) we need to add some pieces to the picture. The mu rhythm, as we have seen, is suppressed during action performance and action observation (desynchronization of the mu rhythm) while it is enhanced as a result of inhibition (synchronization of the mu rhythm). Thus, the mu rhythm is suppressed during action observation, because the sensorimotor cortex is activated, due to motor simulation, and it is enhanced immediately after, because an inhibition mechanism intervenes preventing the simulation from becoming a performed action. The higher the activation of the motor cortex, due to motor simulation, the higher will be the mu rhythm afterwards in the inhibition phase (Babiloni et al., 2002; Pfurtscheller et al., 2006).

In the light of these considerations, Schuch et al. (2010) carried out a study in which changes in the mu rhythm were measured to detect activation of the motor system during action observation, determined by motor simulation and by its inhibition, with the aim of evaluating whether the presumed automatic activation of motor simulation could be modulated as a result of an attentional task participants were instructed to follow. Importantly, the participants in the study did not have to perform any movements. They watched videos that displayed the action of grasping a cup. In each video, simultaneously with the grasping, a grey X on the top of the cup changed to green or blue. In this way, two variables were manipulated: the grasping movement (the cup was grasped by the handle or at the top) and the change of colour (the grey X changed to green or blue).

The experimental task, for all of the participants, was to watch the videos and later, at the end of each experimental block, to make a judgment about the grasping movement or about the colour change. Half of the participants were requested to estimate the percentage of trials in which the cup was grasped by the handle, with a precise grip. The other half were requested to estimate the percentage of trials in which the grey X changed to green. The same videos were displayed to all the participants, the only difference between the groups being the attentional task they were instructed to perform. The prediction advanced by the authors of the study was that, if attention plays a role in modulating motor simulation, then a significantly greater mu suppression had to be expected when participants attended to action than to colour and, as a consequence, the attention to the action condition should also lead to stronger inhibitory enhancement of the mu rhythm.

The prediction was confirmed by experimental results:

> […] the amount of mu suppression during the observation of the grasping actions differed between the two tasks. Participants showed stronger mu suppression during the grasping action when they were later judging the grasp than when later judging the colour change. There was significant mu suppression when initially observing the cup, which indicates motor system activation evoked by the observation of a graspable object (see Chao and Martin 2000; Grezes and Decety 2002; Grezes et al. 2003; Tucker and Ellis 1998). However, when comparing the colour and grasp condition directly, there is no significant difference in mu power between attend-colour and attend-grasp during the pre-stimulus period or during observation of the cup, but there is a significant difference (less mu power when attending grasp) during observation of the action. This suggests that the impact of task relevance of the observed action is largest during the observed action itself. (Schuch et al. 2010, 245)

The results of this study are interesting for the present purposes for two reasons. The data show that mu suppression was found in both conditions. That is, activation in the motor system due to motor simulation was observed both when participants attended to colour change and when they attended specifically to the grasp. Hence, as expected, action observation also triggered motor simulation in the condition in which participants were required to attend to the colour change. These data have been found and widely replicated in hundreds of studies and show that the mechanism of simulation (ESN) is automatically recruited by action observation.

However, the real question was whether motor simulation, and more generally Embodied Simulation, can be modulated by contextual factors (e.g. Cuccio et al., 2014; Iacoboni et al., 2005) and by specific attentional demands entailed by the cognitive tasks carried out while the simulation is taking place. Schuch et al.'s study (2010) found a significant difference in the value of the mu rhythm due to the difference in the attentional task performed by participants. To specifically attend to the grasping movement determined greater activation of motor simulation (presumably, ESB) and, hence, stronger suppression of the mu rhythm as compared to the condition in which attention was paid to the colour change. Colour, indeed, as the authors specified (Schuch et al. 2010, 245), is a characteristic of the stimulus not related to action.

Hence, the mechanism of simulation, independently of its early automatic activation (ESN), which had been confirmed by this and many other studies, can still be modulated by the cognitive task we are currently facing. Attention and other cognitive systems can interact with Embodied Simulation, modulating the degree of involvement of this mechanism.

These findings are clearly in line with the hypotheses proposed at the beginning of this chapter. To deliberately pay attention to the source domain of a metaphor, when the metaphor is bodily based, forces us to pay attention to the stimulus dimension (the source domain meaning) that is related to action and, in general, to bodily knowledge. To deliberately attend to the source domain of bodily metaphors during the processing of a metaphorical sentence should thus be able to recruit the mechanism of Embodied Simulation in a different and much stronger way. In agreement with the hypotheses proposed and with the account of simulation previously presented, it may only be deliberate metaphors that recruit the full activation of the mechanism of simulation (ESB). In this approach to metaphor processing, the key element that makes the difference is the notion of attention.

5.4 Deliberate metaphors and Embodied Simulation

Deliberate metaphors, as pointed out in the previous chapter, are the only metaphors that force us to attend to both the source and the target domains as part of the eventual situation model during linguistic processing. Hence, deliberate metaphors are the only metaphors that require on-line cross-domain mapping. The key criterion for identifying a metaphor as a deliberate metaphor is the notion of attention to the source domain as a distinct area of reference. It is attention to the source domain in the construction of the situation model (see Chapter 4) that makes a metaphor a deliberate metaphor and it is attention to the source domain that makes possible the realization of a metaphorical mapping. By means of this mapping, we then project properties of the source onto the target and we understand the latter in terms of the former.

From the perspective of linguistic processing, to attend to the source domain of metaphors in the situation model determines a higher degree of complexity as compared to the processing of metaphors that do not require us to do so. Everyone who hears or reads a deliberate metaphor has to solve a puzzle. The puzzle consists in making sense of the inconsistent correlation of two conceptual domains that are linguistically associated but not directly related to each other. The task of solving this puzzle is cognitively demanding, and it is solved by means of semantic integration. Language users have to integrate their semantic knowledge with their knowledge of the world and with available contextual information, and so on, in order to understand the meaning of the metaphorical expression. In deliberate metaphor processing, both the source and the target domain of the metaphor need to be accessed and projected into the situation model as distinct referents. According to the model for deliberate metaphor processing developed here, it can be predicted that this juxtaposition between source and target domain referents will happen in the second phase of Friederici's (2011) three-phase model of sentence comprehension and, as previously seen, is reflected by the peak of the N400 component.

When we read or hear bodily-related words or sentences, and this holds true whether they are being used literally or metaphorically, the processing of language automatically and quickly triggers the activation of the mechanism of simulation (ESN). ESN is immediate and automatically activated by the presentation of linguistic stimuli containing words that relate to our body and to the actions we can carry out with it. As Pulvermüller (2012, 443) has pointed out, this somatotopic activation triggered by language comprehension is usually observed very early, taking place around 200 ms after the onset of the linguistic stimulus. The activation of ESN in this early stage of linguistic processing has been shown to be automatic (Pulvermüller, 2012), not requiring any attention or other cognitive effort. In fact, as Pulvermüller (2012) has highlighted, the activation of ESN has been observed when subjects did not attend to and were distracted from the experimental stimuli.

Hence, automatic and early activation of the mechanism of simulation (ESN), in consistency with the hypotheses discussed here, takes place both for literal and metaphorical sentences at the very early stage of the processing of language and in the case of metaphorical sentences, occurs during the processing of both deliberate and non-deliberate metaphors.

However, when bodily-related metaphors are used deliberately they force the hearer to solve a puzzle related to an incongruity detected in the metaphorically used word. The metaphorical meaning is not automatically available and the literal meaning does not fit the co-text in which the word is embedded. To solve this puzzle, the hearer has to pay attention to the metaphorically used word and to build the mapping that will allow her to probably project features of the source onto the target of the metaphor. This work of semantic integration is not carried out automatically and is cognitively demanding. It requires, at least, that the hearer attend to both source and target domain of the metaphor in the situation model.

Semantic integration usually takes place in the second phase of Friederici's (2011) three-phase model for sentence comprehension. This means that, during this second stage, after the first automatic activation of ESN that takes place in the first phase of the model, independently of the literal or metaphorical use of words, and, in case of metaphors, independently of their deliberate or non-deliberate use, language users processing deliberate bodily-related metaphors are forced to pay attention to aspects of the linguistic stimuli that are directly and explicitly related to actions or other kind of bodily experiences. Interlocutors have to attend to the action and bodily dimensions of words because this is a part of their current cognitive task: to make sense of an incongruent linguistic expression.

Attention is clearly key to understanding the contribution that Embodied Simulation makes to the comprehension of these metaphors. It is here hypothesized that, after the first automatic activation of the mechanism of simulation (ESN), attention to the source domain in the situation model during the second phase of linguistic processing modulates the activation of this mechanism. Embodied Simulation is enhanced by cognitively attending to the action dimensions of linguistic stimuli. To explicitly pay attention to bodily meanings makes the simulation stronger (ESB), as was shown for non-linguistic processes in Schuch et al.'s (2010) study. In contrast, during the processing of bodily-related non-deliberate metaphors, after the automatic activation of ESN, it does not follow that ESB is involved. This is because the recruitment of ESB during the processing of bodily-related metaphors is a function of the attention we explicitly pay to both the source and the target domain of the metaphor.

On the basis of this model, it can be hypothesized that early somatotopic activation (ESN) found during the processing of highly conventional and non-deliberate metaphors is not an objection to the present proposal. Indeed, in this view, what makes the difference between deliberate and non-deliberate metaphor processing, with bodily-based metaphors, is the degree of involvement of the mechanism of simulation at later stages of linguistic processing (ESB). In the case of deliberate metaphors, this mechanism is not only kept active at a later stage of language processing. It is also more strongly and broadly involved, thus leading to the involvement of other areas and structures of the brain as discussed in the first chapter of this book.

The mechanism of simulation can therefore fulfil different functions, depending on the context in which it is activated. In social context, it might help us to understand other people's actions, in tool-use behaviours it might prepare us for the action to be performed. In the case of bodily-based metaphors that are processed deliberately, it probably functions as the core mechanism of a predictive coding framework (Kilner, Fristion, Frith, 2007) that leads us to directly feel bodily sensations as if we were really feeling the experiences linguistically described by the bodily-related metaphorical sentences.

Indeed, in this case, the stronger and prolonged simulation likely determines the activation of sensory cortices, as described in the first chapter (ESB). In pure mirroring, in face-to-face interaction, this activation, which triggers the rise of bodily dispositions and sensations, even though these are not often conscious thus allows us to directly understand other people's action and emotions. This is probably what happens when, observing another person suffering, we feel her pain in our own body. During language comprehension, the experience of bodily dispositions and sensations is functional to the cognitive task being carried out. Bodily-related deliberate metaphors, from this point of view, can make very vivid for us the experiences and sensations that are linguistically presented to the extent that we can feel them in our own body, too. ESB, in this case, leads us to have bodily dispositions and sensations related to the bodily-related source domain of the metaphor.

With regard to this last point, it is important to remember that solving the puzzle posed by the processing of a deliberate metaphor is highly beneficial for communicative success. Deliberate metaphors, as we have seen (Chapter 4), function as metaphors in the communicative dimension. From this point of view, the involvement of ESB can enhance their communicative effectiveness. As I have pointed out in previous work (Cuccio, 2015b), the exploitation of ESB can enhance communicative effectiveness for at least two reasons: 1. ESB allows language users to share bodily attitudes and sensations during communicative exchanges; 2. by means of ESB, hearers directly experience the source domain during metaphorical mapping.

It will be useful to discuss these two points a little more. With regard to the first, the sharing of bodily attitudes and sensations during communicative exchanges, the role of ESB in communicative success is twofold. First, speakers (or the writer and the reader), by means of this mechanism, get attuned to each other, sharing a bodily attitude. In this way, they share motor, visceromotor or somatosensory experiences related to actions, emotions or sensations. ESB gives us a preferential channel for the understanding of other people because it directly puts us in the shoes of others. Importantly, this understanding is pre-reflexive, immediate and non-conceptual. When ESB is triggered by bodily-based metaphors, speakers put their interlocutors in the right state to understand them.

The second, consequential, point is that our bodily states affect our cognitive states. To give an example, Strack, Martin and Stepper (1988) proposed, in this regard, the "facial feedback hypothesis". According to this hypothesis, both the configuration and the activation of our facial muscles affect our cognitive states (Strack, Martin, Stepper 1988; Niedenthal et al., 2005). In a famous study, Strack et al. (1988) asked two groups of participants to hold a pencil in their mouths and concurrently rate the funniness of some cartoons. The pencil was held in two different ways: the first group of participants held the pencil between their teeth, which induced a covert smile in the participants; the second group was instructed to hold the pencil between their lips, without touching their teeth, which induced the participants to frown. The results of this study showed that those participants who were led to smile covertly considered the cartoons funnier than the other group. According to the authors' interpretation, assuming a facial expression led the participants to feel the related emotion and this influenced their judgement.

The findings from this study seem to suggest that assuming a bodily state or experiencing a bodily feeling affects our cognitive states (see Wagenmakers et al. 2016 for different results; see Briñol and Petty, 2008 for a review of studies showing how bodily responses can influence attitudes). Bodily-based deliberate metaphors are very apt to exploit this opportunity because, by means of ESB, they let speakers feel bodily feelings that, in turn, affect their judgements about and their conceptualization of the target domain.

With regard to second point, the direct experience of the source domain of metaphors, ESB allows us to feel the experiences that are linguistically described in metaphorical sentences and this makes the mapping itself stronger and more vivid, because the features we project onto the target are vividly present during the mapping.

To conclude, deliberately processed bodily metaphors rely heavily on ESB, which makes this kind of metaphor particularly effective for communication. The present account of metaphor processing relies on theoretical considerations and experimental data from different disciplines concerning the topic of the interaction of attention with the process of language comprehension, on the one hand, and the mechanism of Embodied Simulation, on the other. The notion of deliberateness and the definition of ESB, both discussed in this book, are the links that allow us to put together all the pieces of the puzzle and show the compatibility of the three-phase model of sentence comprehension when applied to the comprehension of metaphors, and the account of the interaction between Embodied Simulation and attention presented in this chapter.

CONCLUSION

Attention to metaphor

From neurons to representations and back

In this final section I would like to highlight the book's main claims. All in all, the book presents no fewer than four new or newly defined topics to the field:

1. A new definition of Embodied Simulation.
2. The distinction between two different but complementary levels of embodiment: embodied metonymic cognition and embodied metaphorical cognition.
3. The distinction between deliberate versus non-deliberate metaphor.
4. A new processing model for metaphor comprehension that takes the notion of attention into account.

The new definition of the mechanism of Embodied Simulation, provided in Chapter 1, is certainly the major philosophical contribution of the book. In fact, in the light of this new account, the overall conception of embodiment has been reconsidered, with potential great impact not only in the field of philosophy but also in the area of metaphor studies. Embodied Simulation has been so far characterized in representational terms (see Chapter 1 for a discussion). As an alternative to this mainstream account, I proposed here that this mechanism should be conceived of in a narrow and in a broad sense (ESN and ESB). I suggested that when conceived in the narrow sense, i.e., when merely defined as a pattern of neural activation, Embodied Simulation cannot involve any representational description. By contrast, when conceived in the broad sense, i.e., when described as a complex phenomenon that sets a bodily attitude and often makes us able to re-enact or simulate in our own body sensations and experiences observed in others or invoked by linguistic processing, mental imagery, and so on, it does involve representational content. ESB, with its bodily and not merely neural characterization, allows us to bridge the gap that goes from the level of neurons to the personal level of experience and helps us to understand the specific cognitive contribution provided by this mechanism.

In the light of, and in accordance with, this new definition of the mechanism of simulation, I also proposed a reconsideration of the use of the term "body" in the embodiment literature. To this purpose, I presented the distinction between body schema and body image, I clarified their use and, on this basis, I identified two levels of embodiment: (i) the level of invisible metonymic cognition that has body schemas as its source domains and (ii) the level of visible metaphors that have body images as their source domains.

The level of embodied metonymic cognition is foundational to any possibility of perception and cognition At this level, the body is not the object of our attention and explicit knowledge. It is, instead, the precondition of the possibility of action and knowledge. In this case, the contribution of the body to thought and language is direct. Instead, at the second level of embodiment, i.e., at the level of embodied metaphorical cognition, the body contributes to cognition being already the object of a representation that is culturally, linguistically and historically situated. conceptual metaphors, in this view, are located at this second level of embodiment.

Furthermore, with regard to the debate on the conceptual nature of metaphors, the book, with a guest contribution by Gerard Steen, also discussed an innovative conception of the processing of conceptual metaphors. In fact, in Chapter 4, Steen presented his distinction between deliberate and non-deliberate processing of metaphors. Attention, in his approach, is a key notion in delineating this distinction. The attention we pay to the referential function of the source domain of a metaphor during linguistic processing makes a metaphor a deliberately processed metaphor. Only when it is deliberately processed does a metaphor involve a mapping from the source to the target domain at the the level of reference, with the paradoxical consequence that many metaphors are not processed as metaphors in this way.

In this light, and in consideration of the results achieved in the previous chapters of the book, in Chapter 5 I finally developed a new model of metaphor processing that put together the notion of attention and the notion of deliberateness, on the one hand, and the new account of the mechanism of Embodied Simulation, on the other. In this model, attention to the source domain, due to deliberate processing of metaphors, differently modulates the activation of the mechanism of simulation, compared to the processing of non-deliberate bodily-related metaphors. Only deliberate metaphors recruit ESB. This model of embodied metaphor processing might provide us the key to read again, in a new perspective, neuroscientific findings on the comprehension of bodily related metaphors.

In fact, neuroscientific research (see Chapter 2 for a discussion) has shown that metaphor processing somatotopically recruits the motor system. However, these data are still controversial and divergent findings have also been obtained (Raposo et al., 2009; Cacciari et al., 2011; Lai & Curran, 2013). The contrasting results might be accounted for, in the model here proposed, in the light of the distinction between deliberate and not-deliberate processing of metaphors. Only when deliberately processed, metaphors triggers ESB and this determines a late somatotopic activation of the motor system that is not observed during the processing of not-deliberate metaphors.

As is clear, the embodied nature of human cognition is a central topic in different fields of research such as philosophy, the cognitive sciences and the field of metaphor studies. The four main ideas that this book suggests cut across and impact all of them. In fact, the newly defined topics here presented provide the basis to reframe the notion of embodiment, to address crucial problems in the relevant debates and, all in all, to significantly reconsider the embodied nature of human cognition and its relation to metaphor processing.

In this final section I would also like to identify and briefly discuss some topics I only touched upon in the previous chapters and that are currently on the agenda for future research. These topics are related to the contextual and hence cultural foundation of metaphorical cognition. Culture is, indeed, an intrinsic element of every context.

CMT has recently been accused of proposing a new, masked, form of Cartesianism (Leezenberg 2009, 144). The reason is that the focus of attention for many scholars working in this research paradigm seems to be on the mind/brain of individuals. The theses presented in this book offer a picture of embodiment in which our cognition has an unequivocal and intrinsic social dimension. Solipsistic approaches certainly do not do justice to the social nature of the human mind and to its bodily foundation, as Gallese has repeatedly pointed out (e.g. Ammaniti and Gallese 2014; Gallese and Cuccio, 2016). According to Gallese, the body contributes to ensuring that cognition is always part of a context that we share with others. And the others are other human beings we are currently interacting with but also every physical object and every cultural entity we can interface with. This view of embodiment sheds light on the way the body contributes to cognition as, ontologically speaking, a social entity from the very beginning. Gallese and Cuccio (2016) have clearly pointed to this specific aspect of embodiment, which is deeply grounded in intersubjectivity. In their view, subjectivity is built on intersubjectivity and the embodied nature of our cognition greatly contributes to this.

> One of the consequences of the discovery of mirror neurons was the possibility of deriving subjectivity from intersubjectivity at the sub-personal level of description. The sense of self is precociously developed, beginning from a self that is first of all physical and bodily, and which is constituted precisely by the possibility of interacting and acting with the other. Embodied Simulation can provide the neurobiological basis for early forms of intersubjectivity, from which the sense of the self is built. The discovery of mirror neurons and the simulation mechanism would therefore seem to further stress that being a self also implies being with the other. The model of intersubjectivity suggested by mirror mechanisms and Embodied Simulation correlatively sheds new light on the subjective dimension of existence. (Gallese and Cuccio 2016, 23)

For this reason, the current proposal about embodiment and its role in metaphorical cognition is immune to the objection that it is a masked form of Cartesianism, as has been imputed to CMT by Leezenberg (2009). Intersubjectivity is an intrinsic part of this account of embodiment. Even though all of this may eventually become more generally acceptable, we must admit that more research is needed to better understand how contextual factors, in the broadest sense of the notion of context including people, objects, situations and cultures, can interact with embodiment at both the levels identified in this book. The question to ask, to avoid the risk of solipsism, is to what extent context can be considered to have a constitutive role in shaping body schemas and body images. In other words, it is not sufficient to study how the body contributes to our understanding of others, to the comprehension of language, to conceptual processing, and so on. We also need to investigate the ways contextual factors can contribute to the structures and processes of embodied cognition.

While the answer to this question intuitively seems to be clearer with regard to body images, it is not so clear when we turn to the body schema. Our representations of the body are inevitably tied to the linguistic, historical and cultural context in which we are embedded. Can we say the same for body schemas?

The answer is yes, to a certain extent. On the one hand, it is true that we as humans are endowed with the same kind of body. This biological body is a constraint that determines the kind of experiences that we can have and the kind of experiences we cannot have. Our cognition is basically built on the basis of these common constraints. This common basis, for example the fact that we stand erect, that we have five senses, that our brain is built in a certain way, is the source of common, universal, aspects of human cognition.

On the other hand, we need to acknowledge that our experiences, even as they are constrained by the limits imposed by our body, are also deeply grounded in culture and practice. To give some examples, some of our motor programmes, and the corresponding actions, can be considered innate. Swallowing is a good candidate for an innate motor programme. But even innate motor programmes need to be refined with practice. By contrast, many other motor programmes, and the corresponding actions, are entirely learned and hence dependent on contextual factors. Writing or riding a bicycle are good examples of learned motor programs. A particularly strong example of the interaction between innate aspects and practice is sight. Clearly, we see because we are equipped for this. We have a sensitive apparatus that allows us to see things. Sight is from this point of view, undoubtedly, a universal experience. However, to be able to see, we need to learn how to do it, we need practice. To be equipped with the right sensitive apparatus cannot be enough. Proof of this is the fact that congenitally blind individuals who have had their sight surgically restored are not able to see immediately after the surgery even if they are perfectly capable of receiving visual stimuli (see Chapter 3 for a deeper discussion of this example).

Even the level of embodied metonymic cognition described in Chapter 3 of this book is, then, a level at which universal aspects of embodiment interact with situations and context. Sight, again, is not just the passive receiving of visual stimuli. It is a metonymic correlation between motor abilities and sensations.

To investigate the contextually determined nature of embodiment, at both the levels identified in this book, is, then, the next point on the agenda.

References

Abreu, A. M., Macaluso, E., Azevedo, R. T., Cesari, P., Urgesi, C., & Aglioti, S. M. (2012). Action anticipation beyond the action observation network: a functional magnetic resonance imaging study in expert basketball players. *Eur. J. Neurosci*. 35, 1646–1654. https://doi.org/10.1111/j.1460-9568.2012.08104.x

Ahmad, A. H., & Abdul Aziz, C. B. (2014). The Brain in Pain. *The Malaysian Journal of Medical Sciences: MJMS*, 21(Spec Issue), 46–54.

Allbritton, D. W., McKoon, G., & Gerrig, R. (1995). Metaphor-based schemas and text representations: Making connections through conceptual Metaphors. *Journal of Experimental Psychology*, 21(3), 612–625.

Alsmith, A., & de Vignemont, F. (2012). Embodying the mind and representing the body. *Review of Philosophy and Psychology, special issue*, 3(1), 1–13. https://doi.org/10.1007/s13164-012-0085-4

Alverson, H. (1994). *Semantics and Experience: Universal Metaphors of Time in English, Mandarin, Hindi, and Sesotho*. Baltimore: Johns Hopkins University Press.

Ammaniti, M. & Gallese, V. (2014). *The Birth of Intersubjectivity. Psychodynamics, Neurobiology and the Self*. New York and London: W. W. Norton & Company.

Andersen R. A., Snyder L. H., Bradley D. C., Xing J. (1997) Multimodal representation of space in posterior parietal cortex and its use in planning movements. *Ann. Rev. Neurosci* 20:167–170.

Aziz-Zadeh, L., Maeda, F., Zaidel, E., Mazziotta, J., & Iacoboni, M. (2002). Lateralization in motor facilitation during action observation: a TMS study. *Exp Brain Res*, 144(1), 127–131. https://doi.org/10.1007/s00221-002-1037-5

Babiloni, C., Babiloni, F., Carducci, F., Cincotti, F., Cocozza, G., Del Percio, C., Moretti, D. V., & Rossini, P. M. (2002). Human cortical electroencephalography (EEG) rhythms during the observation of simple aimless movements: a high-resolution EEG study. *Neuroimage*, 17, 559–572. https://doi.org/10.1006/nimg.2002.1192

Bach, P., Peatfield, N., & Tipper, S. P. (2007) Focusing on body sites: the role of spatial attention in action perception. *Exp Brain Res*, 178, 509–517. https://doi.org/10.1007/s00221-006-0756-4

Bailey, D. (1998). *Getting a grip: A computational model of the acquisition of verb semantics for hand actions*. Unpublished Ph.D. dissertation, International Computer Science Institute, University of California, Berkeley.

Baker, P. (2006). *The Washington Post October* 24, A01.

Baldissera, F., Cavallari, P., Craighero, L., & Fadiga, L. (2001). Modulation of spinal excitability during observation of hand actions in humans. *Eur J Neurosci*, 13(1), 190–194. https://doi.org/10.1046/j.0953-816x.2000.01368.x

Barcelona, A. (Ed.). (2000). *Metaphor and Metonymy at the Crossroads*. Berlin: Mouton de Gruyter.

Barsalou, L. W. (1999). Perceptual symbol systems. *Behav Brain Sci*, 22(4), 577–609; discussion 610–560.

Barsalou, L. W. (2008). Grounded cognition. *Annu Rev Psychol*, 59, 617–645. https://doi.org/10.1146/annurev.psych.59.103006.093639

Bechtel, W. & Mundale, J. (1999). Multiple Realizability Revisited: Linking Cognitive and Neural States. *Philosophy of Science*, 66, 175–207. https://doi.org/10.1086/392683

Bergen, B. (2005). Mental simulation in literal and figurative language understanding. In S. Coulson & B. Lewandowska-Tomaszczyk (Eds.) *The literal and nonliteral in language and thought* (pp. 255–280). Berlin: Lang.

Bergen, B., Lindsay, S., Matlock, T. & Narayanan, S. (2007). Spatial and linguistic aspects of visual imagery in sentence comprehension. *Cognitive Science*, 31, 733–764. https://doi.org/10.1080/03640210701530748

Berlucchi, G. & Aglioti, S. (1997). The body in the brain: Neural bases of corporeal awareness. *Trends in Neurosciences*, 20, 560–564. https://doi.org/10.1016/S0166-2236(97)01136-3

Blasko, D., & Briihl, D. (1997). Reading and recall of metaphorical sentences: effects of familiarity and context. *Metaph.Symbol*. 12, 261–285. https://doi.org/10.1207/s15327868ms1204_4

Blasko, D., & Connine, C. (1993). Effects of familiarity and aptness on metaphor processing. *J. Exp. Psychol. Learn. Mem. Cogn*. 19, 295–308. https://doi.org/10.1037/0278-7393.19.2.295

Block, N. (2005). Two neural correlates of consciousness. *Trends Cogn Sci*. Feb;9(2):46–52. https://doi.org/10.1016/j.tics.2004.12.006

Boers, F. (2004). Expanding learners' vocabulary through metaphor awareness: What expansion, what learners, what vocabulary?. In S. Niemeier, & M. Achard (Eds.) *Cognitive linguistics, second language acquisition, and foreign language teaching* (pp. 211–234). Berlin/New York: Mouton de Gruyter. https://doi.org/10.1515/9783110199857.211

Boers, F., & Littlemore, J. (2000). Cognitive style variables in participants' explanations of conceptual Metaphors. *Metaphor and Symbol*, 15, 177–187. https://doi.org/10.1207/S15327868MS1503_4

Boot, I. & D. Pecher. 2010. Similarity is closeness: Metaphorical mapping in a conceptual task. *The Quarterly Journal of Experimental Psychology* 63(5). 942–954.

Bonnier, P. (1905). L'Aschématie [Aschematia]. *Revue Neurologique*, 13, 605–609.

Borbely, A. (2004). Toward a psychodynamic understanding of metaphor and metonymy: Their role in awareness and defense. *Metaphor and Symbol*, 19, 91–114. https://doi.org/10.1207/s15327868ms1902_1

Borghi, A.M., Barca, L., Binkofski, F. and Tummolini, L. (2018). Theme issue 'Varieties of abstract concepts: development, use and representation in the brain', *Philosophical Transactions of the Royal Society B: Biological Sciences*, Vol. 373, No. 1752.

Borghi, A. M., Binkofski, F., Castelfranchi, C., Cimatti, F., Scorolli, C., Tummolini, L. (2017). The challenge of abstract concepts. *Psychol Bull. Mar*;143(3):263–292. https://doi.org/10.1037/bul0000089

Boroditsky, L. (2000). Metaphoric structuring: Understanding time through spatial Metaphors. *Cognition*, 75, 1–28. https://doi.org/10.1016/S0010-0277(99)00073-6

Boroditsky, L. (2001). Does language shape thought? English and Mandarin speakers' conceptions of time. *Cognitive Psychology*, 43, 1–22. https://doi.org/10.1006/cogp.2001.0748

Boroditsky, L. & Ramscar, M. (2002). The roles of body and mind in abstract thought. *Psychological Science*, 13, 185–189. https://doi.org/10.1111/1467-9280.00434

Borroni, P., Montagna, M., Cerri, G., & Baldissera, F. (2005). Cyclic time course of motor excitability modulation during the observation of a cyclic hand movement. *Brain Res*, 1065(1–2), 115–124. https://doi.org/10.1016/j.brainres.2005.10.034

Bortfeld, H. & McGlone, M. (2001). The continuum of metaphor processing. *Metaphor and Symbol*, 16, 75–86. https://doi.org/10.1080/10926488.2001.9678887

Boulenger, V., Hauk, O., & Pulvermüller, F. (2009). Grasping ideas with the motor system: semantic somatotopy in idiom comprehension. *Cereb Cortex*, 19(8), 1905–1914. https://doi.org/10.1093/cercor/bhn217

Boulenger, V., Shtyrov, Y., & Pulvermüller, F. (2012). When do you grasp the idea? MEG evidence for instantaneous idiom understanding. *Neuroimage*, 59(4), 3502–3513. https://doi.org/10.1016/j.neuroimage.2011.11.011

Bowdle, B., & Gentner, D. (2005). The career of metaphor. *Psychol.Rev*. 112, 193–216. https://doi.org/10.1037/0033-295X.112.1.193

Brandt, V. C., Moczydlowski, A., Jonas, M., Boelmans, K.,, Bäumer, T., Brass, M., Münchau, A. (2017) Imitation inhibition in children with Tourette Syndrome. *J Neuropsychol*. https://doi.org/10.1111/jnp.12132

Brass, M., Ruby, P., Spengler, S. (2009). Inhibition of imitative behaviour and social cognition. *Philos Trans R Soc Lond B Biol Sci*, 364, 2359–2367. https://doi.org/10.1098/rstb.2009.0066

Brentano, F. (1874). *Psychology from an Empirical Standpoint*. Translated by A. C. Rancurello, D. B. Terrell & L. McAlister. London: Routledge, 1973.

Briñol, P., & Petty, R. E. (2008). Embodied persuasion: Fundamental processes by which bodily responses can impact attitudes. In G. R. Semin & E. R. Smith (Eds.), *Embodiment grounding: Social, cognitive, affective, and neuroscientific approaches* (pp. 184–207). Cambridge, England: CUP. https://doi.org/10.1017/CBO9780511805837.009

Brooks, R. (1991). Intelligence Without representation. *Artificial Intelligence*, 47, 139–159. https://doi.org/10.1016/0004-3702(91)90053-M

Brookshire, G., Ivry, R., & Casasanto, D. (2010). Modulation of motor-meaning congruity effects for valenced words. In S. Ohlsson & R. Catrambone (Eds.), *Proceedings of the 32nd annual conference of the Cognitive Science Society* (pp. 1940–1945). Austin, TX: Cognitive Science Society.

Brown, T. (2003). *Making truth: Metaphor in science*. Champaign, IL: University of Illinois Press.

Brunyé, T. T., Gardony, A., Mahoney C. R. & Holly A. T. (2012). Body-specific representations of spatial location. *Cognition* 123(2), 229–239. https://doi.org/10.1016/j.cognition.2011.07.013

Buccino, G., Vogt, S., Ritzl, A., Fink, G. R., Zilles, K., Freund, H. J., Rizzolatti, G. (2004). Neural circuits underlying imitation learning of hand actions: an event-related fMRI study. *Neuron. Apr* 22;42(2):323–334

Cacciari, C., Bolognini, N., Senna, I., Pellicciari, M. C., Miniussi, C., & Papagno, C. (2011). Literal, fictive and metaphorical motion sentences preserve the motion component of the verb: a TMS study. *Brain Lang*, 119(3), 149–157. https://doi.org/10.1016/j.bandl.2011.05.004

Cacioppo, S., Juan, E., Monteleone, G. (2017). Predicting Intentions of a Familiar Significant Other Beyond the Mirror Neuron System. *Front Behav Neurosci*. 25;11:155. https://doi.org/10.3389/fnbeh.2017.00155

Calbris, G. (1990). *The semiotics of French gestures*. Bloomington, IN: Indiana University Press.

Cameron, L. (2007). Patterns of metaphor in reconciliation talk. *Discourse and Society*, 18, 197–222. https://doi.org/10.1177/0957926507073376

Carapezza, M., Cuccio V. (2018). Abductive inferences in pragmatic processes, in Capone A., Carapezza M. (eds.), *Perspectives in Pragmatics, Philosophy & Psychology*, Vol. 18,: *Further Advances in Pragmatics and Philosophy*, pp. 221–242, Springer, Cham. ISBN 978-3-319-72172-9. https://doi.org/https://doi.org/10.1007/978-3-319-72173-6_11

Carr, L., Iacoboni, M., Dubeau, M. C., Mazziotta, J. C., & Lenzi, G. L. (2003). Neural mechanisms of empathy in humans: a relay from neural systems for imitation to limbic areas. *Proc Natl Acad Sci USA*, 100(9), 5497–5502. https://doi.org/10.1073/pnas.0935845100

Caruana, F., Cuccio, V. (2017). Types of abduction in tool behaviour. *Phenomenology and the Cognitive Sciences, Springer*, Volume 16, Issue 2, pp 255–273. https://doi.org/10.1007/s11097-015-9450-y

Casasanto, D. (2008). Similarity and proximity: When does close in space mean close in mind? *Memory & Cognition* 36(6). 1047–1056.

Casasanto, D. (2009). When is a linguistic metaphor a conceptual metaphor? In V. Evans, & S. Pourcel (Eds.), *New directions in cognitive linguistics* (pp. 127–145). Amsterdam: Benjamins. https://doi.org/10.1075/hcp.24.11cas

Casasanto, D. & Boroditsky, L. (2008). Time in the mind: Using space to think about time. *Cognition*, 106, 579–593. https://doi.org/10.1016/j.cognition.2007.03.004

Casasanto, D. & K. Dijkstra. (2010). Motor action and emotional memory. *Cognition* 115(1). 179–185.

Casasanto, D. & R. Bottini. (2014). Spatial language and abstract concepts. *WIREs Cognitive Science*, 5. 139–149.

Citron, F. M. M. & A.E. Goldberg. (2014a). Social context modulates the effect of physical warmth on perceived interpersonal kindness: A study of embodied metaphors. *Language and Cognition* 6(1). 1–11.

Casasanto, D., & Gijssels, T. (2015). What makes a metaphor an embodied metaphor?. *Linguistics Vanguard*. https://doi.org/10.1080/0163853X.2015.1023965

Chalmers , D. (1995). Facing up to the problem of consciousness. *Journal of Consciousness studies*, 2(3), 200–219.

Chemero, A., (2009). *Radical embodied cognitive science*. Cambridge, Massachusetts; London: The MIT Press.

Chen, J. -Y. (2007). Do Chinese and English speakers think about time differently? Failure of replicating Boroditsky (2001). *Cognition*, 104, 427–436. https://doi.org/10.1016/j.cognition.2006.09.012

Cochin, S., Barthelemy, C., Roux, S., & Martineau, J. (1999). Observation and execution of movement: similarities demonstrated by quantified electroencephalography. *Eur J Neurosci*, 11, 1839–1842. https://doi.org/10.1046/j.1460-9568.1999.00598.x

Chao, L., Martin, A. (2000). Representation of manipulable man-made objects in the dorsal stream. *Neuroimage*, 12, 478–484. https://doi.org/10.1006/nimg.2000.0635

Chomsky, N. (1965). Aspects of the theory of syntax. In *Multilingual Matters*. Cambridge: The MIT Press.

Churchland, P. (1986). *Neurophilosophy: Toward a Unified Science of the Mind-Brain*. Cambridge, Massachusetts: The MIT Press.

Cienki, A. (1998). Metaphoric gestures and some of their relations to verbal metaphoric expressions. In J. -P. Koenig (Ed.) *Discourse and cognition* (pp. 189–204). Stanford, CA: CSLI Publications.

Cienki, A., & Mueller, C., (Eds.) (2008). *Metaphor and gesture*. Amsterdam: John Benjamins. https://doi.org/10.1075/gs.3

Clark, A. (1997). *Being there: putting brain, body, and world together again*. Cambridge, Massachusetts; London: The MIT Press.
Clark, A. (2008). *Supersizing the Mind: Embodiment, Action, and Cognitive Extension*. Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195333213.001.0001
Clark, A. (2016a). Embodied prediction. In T. Metzinger and J. M. Windt (eds.), *Open MIND*: 7(T), Cambridge, Massachussetts: The MIT Press.
Clark, A. (2016b). Predicting peace: Reply to Madary. In T. Metzinger and J. M. Windt (eds.), *Open MIND*: 7(T), , Cambridge, Massachussetts: The MIT Press.
Clark, A. (2016c). *Surfing Uncertainty: Prediction, Action and the Embodied Mind*. Oxford University Press https://doi.org/10.1093/acprof:oso/9780190217013.001.0001
Clark, A., & Grush, R. (1999). Towards a cognitive robotics. *Adaptive Behavior*, 7(1), 5–16. https://doi.org/10.1177/105971239900700101
Clark, S., Tremblay, F., & Ste-Marie, D. (2004). Differential modulation of corticospinal excitability during observation, mental imagery and imitation of hand actions. *Neuropsychologia*, 42(1), 105–112. https://doi.org/10.1016/S0028-3932(03)00144-1
Cole, J. (1995). *Pride and a daily marathon*. Cambridge, Massachusetts: The MIT Press.
Cole, J., & Paillard, J. (1995). Living without touch and information about body position and movement. Studies on deafferented subjects. In J. Bermudez, A. Marcel, & N. Iylan (Eds.), *The Body and the Self*. (pp. 24–266). Cambridge, Massachusetts: The MIT Press.
Columbus, G., Sheikh, N. A., Côté-Lecaldare, M., Häuser, K., Baum, S. R., & Titone, D. (2014). Individual differences in executive control relate to metaphor processing: an eye movement study of sentence reading. *Frontiers in human neuroscience*, 13(8), 1–12. https://doi.org/10.3389/fnhum.2014.01057
Costantini, M., Galati, G., Ferretti, A., Caulo, M., Tartaro, A., Romani, G. L., & Aglioti, S. M. (2005) Neural systems underlying observation of humanly impossible movements: an FMRI study. *Cereb. Cortex*, 15, 1761–1767. https://doi.org/10.1093/cercor/bhi053
Coulter, R., Zaltman, G., & Coulter, K. (2001). Interpreting consumer perceptions of advertising: An application of the Zaltman metaphor elicitation technique. *Journal of Advertising*, 30, 1–22. https://doi.org/10.1080/00913367.2001.10673648
Crawford, Elizabeth L., Skye M. Margolies, John T. Drake & Meghan E. Murphy. 2006. Affect biases memory of location: Evidence for the spatial representation of affect. *Cognition and Emotion* 20(8). 1153–1169.
Crawford, E. (2009). Conceptual metaphors of affect. *Emotion Review*, 1, 129–139. https://doi.org/10.1177/1754073908100438
Croft, W., & Cruse, A. (2004). *Cognitive linguistics*. New York, NY: Cambridge University Press. https://doi.org/10.1017/CBO9780511803864
Cross, K. A., Torrisi, S., Reynolds Losin, E. A., & Iacoboni, M. (2013). Controlling automatic imitative tendencies: interactions between mirror neuron and cognitive control systems. *Neuroimage*, 83, 493–504. https://doi.org/10.1016/j.neuroimage.2013.06.060
Cuccio, V. (2008). *Dire lo spazio. Linguaggio spazialità e sindrome di Williams*. Catania: Bonanno Editore.
Cuccio, V. (2015a). The notion of representation and the brain. *Phenomenology and Mind*, 7, 247–258.
Cuccio, V. (2015b). Embodied Simulation and Metaphors. Towards a direct role of the body in language comprehension. *Epistemologia*, 37, 97–112.

Cuccio V. (2017). Body-schema and body-image in metaphor processing in B. Hampe, (ed.), *Metaphor. Embodied Cognition and Discourse*, Cambridge, UK: Cambridge University Press. https://doi.org/10.1017/9781108182324.006
Cuccio, V., Ambrosecchia, M., Ferri, F., Carapezza, M., Lo Piparo, F., Fogassi, L. & Gallese, V. (2014). How the context matters. Literal and figurative meaning in the embodied language paradigm. *PlosOne*, 9(12), 1–24. https://doi.org/10.1371/journal.pone.0115381
Cuccio V., Gallese V. (2018). Grounding abstraction in phylogeny: A comparative neuroscientific perspective, *Philosophical Transactions of the Royal Society B*. Vol. 373, 1752. https://doi.org/10.1098/rstb.2017-0128
Cuykens, H., & Zawada, B. (Eds.) (2001). *Polysemy in cognitive linguistics*. Amsterdam, the Netherlands: John Benjamins. https://doi.org/10.1075/cilt.177
Damasio, A. (1994). *Descartes's error. motion, Reason, and the Human Brain*. New York: Avon Books.
Decety, J. and Grezes, J. (1999). Neural mechanisms subserving the perception of human action. *Trends in Cognitive Sciences*, 3, 172–178.
Deignan, A. (2006). *Metaphor in corpus linguistics*. Amsterdam: John Benjamins.
Dennett, D. C. (1969). *Content and consciousness*. London: Routledge & Kegan Paul.
Dennett, D. C. (1987). *The intentional stance*. Cambridge, Massachusetts; London: The MIT Press.
Denny-Brown, D., Meyer, J. S., Horenstein, S. (1952). The significance of perceptual rivalry resulting from parietal lesion. *Brain*, 75, 433–471. https://doi.org/10.1093/brain/75.4.432
De Renzi, E., Cavalleri, F., & Facchini, S. (1996). Imitation and utilisation behaviour. *J Neurol Neurosurg Psychiatry*, 61(4), 396–400. https://doi.org/10.1136/jnnp.61.4.396
Desai, R. H., Binder, J. R., Conant, L. L., Mano, Q. R. & Seidenberg, M. S. (2011). The neural career of sensory-motor Metaphors. *J Cogn Neurosci*, 23(9), 2376–2386. https://doi.org/10.1162/jocn.2010.21596
Desai, R. H., Conant, L. L. Binder, J. R., Park, H., & Seidenberg, M. S. (2013). A piece of the action: modulation of sensory-motor regions by action idioms and Metaphors. *Neuroimage*, 83, 862–869. https://doi.org/10.1016/j.neuroimage.2013.07.044
De Vignemont, F. (2010). The body-schema and the body-image. Pros and Cons. *Neuropsychologya*, 48(3), 669–680. https://doi.org/10.1016/j.neuropsychologia.2009.09.022
Dreyfus, H. L. (2002), Intelligence without representation – Merleau-Ponty's critique of mental representation. The relevance of phenomenology to scientific explanations, *Phenomenology and the Cognitive Sciences* 1: 367–383, 2002.
Dijkerman, H. C., & de Haan, E. H. (2007). Somatosensory processes subserving perception and action. *Behav Brain Sci*, 30(2), 189–201; discussion 201–139. https://doi.org/10.1017/S0140525X07001392
Dretske, F. (1995). *Naturalizing the Mind*. Cambridge, Massachusetts: The MIT Press.
Dudschig, C., de la Vega, I., & Kaup, B.(2014). Embodiment and second-language: Automatic activation of motor responses during processing spatially associated L2 words and emotion L2 words in a vertical Stroop paradigm. *Brain and Language*, 132, 14–21. https://doi.org/10.1016/j.bandl.2014.02.002
Eerden, B. (2009). Anger in Asterix: The metaphorical representation of anger in comics and animated films. In C. Forceville & E. Urios-Aparisi (Eds), *Multimodal Metaphor* (pp. 243–264). Berlin: Mouton de Gruyter.
Eubanks, P. (2000). *A war of words in the discourse of trade: The rhetorical constitution of metaphor*. Carbondale, IL: Southern Illinois University Press.

Evans, V., & Green, M. (2006). *Cognitive linguistics: An introduction*. Edinburgh, UK: Edinburgh University Press.

Fadiga, L., Fogassi, L., Pavesi, G., & Rizzolatti, G. (1995). Motor facilitation during action observation: a magnetic stimulation study. *J Neurophysiol*, 73(6), 2608–2611. https://doi.org/10.1152/jn.1995.73.6.2608

Fahlenbrach, K. (2005). The emotional design of music videos: Approaches to audiovisual Metaphors. *Journal of Moving Images Studies*, 3(1), 22–28.

Fahlenbrach, K. (2007). Embodied spaces: Film spaces as (leading) audiovisual Metaphors. In J. D. Anderson, & B. Fisher-Anderson (Eds.), *Narration and Spectatorship in Moving Images* (pp. 105–123). Cambridge, MA, USA: Cambridge Scholars Press.

Fauconnier, G. & Turner, M. (2002). *The way we think: Conceptual blending and the mind's hidden complexities*. New York, NY: Basic Books.

Ferrari, G. (2006). Architectural space as metaphor in the Greek sanctuary. In M. Turner (Ed.), *The artful mind* (pp. 225–242). New York, NY: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195306361.003.0012

Feldman, J. (2006) *From molecule to Metaphor. A Neural Theory of Language*. Cambridge, Massachusetts: The MIT Press.

Feldman, J., & Narayanan, S. (2004). Embodied Meaning in a Neural Theory of Language. *Brain and Language*, 89, 385–392. https://doi.org/10.1016/S0093-934X(03)00355-9

Ferraresi M. (1983). Le abduzioni nel testo ,*Versus*, 34, 59–77.

Fillmore, C. (1968). The case for case. In E. Bach & R. Harms (Eds.), *Universals in linguistic theory* (pp. 1–90). New York: Holt, Rinehart & Winston.

Fillmore, C. (1982). Frame semantics. In Linguistic Society of Korea (Ed.), *Linguistics in the morning calm* (pp. 111–138). Seoul: Hanshin.

Fodor, J. A. (1983). *Modularity of mind: an essay on faculty psychology*. Cambridge, Massachusetts: The MIT Press.

Fodor, J. and Pylyshyn, Z. (1988). Connectionism and Cognitive Architecture: A Critical Analysis, *Cognition*, 28: 3–71. https://doi.org/10.1016/0010-0277(88)90031-5

Fisher, S. (1972). Body-image. In D. Sills (Ed.), *International Encyclopaedia of the Social Sciences. ii*. New York: Collier-Macmillan; repr. in T. Polhemus (Ed.), *The Body Reader: Social Aspects of the Human Body* (pp. 115–121). New York: Pantheon Books, 1978.

Forceville, C. (1998). *Pictorial Metaphor in Advertising*. London: Routledge.

Forceville, C. (2002). The identification of target and source in pictorial Metaphors. *Journal of Pragmatics*, 34, 1–14. https://doi.org/10.1016/S0378-2166(01)00007-8

Forceville, C. (2005). Visual representations of the idealized cognitive model of anger in the Asterix album. La Zizanie. *Journal of Pragmatics*, 37, 69–88. https://doi.org/10.1016/j.pragma.2003.10.002

Forceville, C. (2006). The source-path-goal schema in the autobiographical journey documentary. *New Review of Film and Television Studies*, 4(3), 241–261. https://doi.org/10.1080/17400300600982023

Foroni, F., & Semin, G. R. (2009). Language that puts you in touch with your bodily feelings: the multimodal responsiveness of affective expressions. *Psychol Sci*, 20(8), 974–980. https://doi.org/10.1111/j.1467-9280.2009.02400.x

Fowler, C., Richardson, M., Marsh, K., & Shockley, K. (2008). Language use, coordination, and the emergence of cooperative action. In A. Fuchs & V. Jirsa (Eds.), *Coordination: Neural, behavioral, and social dynamics* (pp. 161–180). Berlin: Springer-Verlag. https://doi.org/10.1007/978-3-540-74479-5_13

Freedberg, D., and Gallese, V. (2007). Motion, emotion and empathy in esthetic experience. *Trends Cogn Sci*.;11(5):197–203. https://doi.org/10.1016/j.tics.2007.02.003

Freeman, D. (1995). Catch(ing) the nearest way: Macbeth and cognitive metaphor. *Journal of Pragmatics*, 24, 689–708. https://doi.org/10.1016/0378-2166(95)00015-K

Friederici, A. D. (2011). The brain basis of language processing: from structure to function. *Physiological Reviews*, 91(4), 1357–1392. https://doi.org/10.1152/physrev.00006.2011

Friederici, A. D. (2002). Towards a neural basis of auditory sentence processing. *Trends in Cognitive Sciences*, 6(2), 78–84. https://doi.org/10.1016/S1364-6613(00)01839-8

Fusaroli, R. & Morgani, S. (Eds.). (2013). Conceptual Metaphor Theory: Thirty Years After, Thematic Issue. *Cognitive Semiotics*, 5(2), 1–13.

Gallagher, S. (1986). Body image and body schema: A conceptual clarification. *Journal of Mind and Behavior*, 7, 541–554.

Gallagher, S. (2005). *How the body shapes the mind*. New York: Oxford University Press. https://doi.org/10.1093/0199271941.001.0001

Gallagher, S. (2007). Simulation trouble. *Social Neuroscience*, 2(3–4), 353–365. https://doi.org/10.1080/17470910601183549

Gallagher, S. (2008). Neural simulation and social cognition. In J. A. Pineda (Ed.), *Mirror neuron systems: The role of mirroring processes in social cognition* (pp. 355–371). Totowa, NJ: Humana Press. https://doi.org/10.1007/978-1-59745-479-7_16

Gallagher, S. (2015). Reuse and body-formatted representations in simulation theory. *Cognitive Systems Research*, 34–35, 35– 43. https://doi.org/10.1016/j.cogsys.2015.07.003

Gallagher, S., & Cole, J. (1995) Body image and body schema in a deafferented subject. *J Mind and Behav*, 16,369–389.

Gallagher, S. & Zahavi, D. (2008). *The Phenomenological Mind*. 2nd edition, London; New York: Routledge.

Gallese, V. (2005). Embodied simulation: From neurons to phenomenal experience. *Phenomenology and the Cognitive Sciences*, Vol. 4, 1, pp 23–48. https://doi.org/10.1007/s11097-005-4737-z

Gallese, V. (2013). Mirror neurons, embodied simulation and a second-person approach to mindreading. *Cortex*, 49(10), 2954–2956. https://doi.org/10.1016/j.cortex.2013.09.008

Gallese, V., & Cuccio V. (2016). The paradigmatic body. embodied simulation, intersubjectivity, the bodily self and language. In T. Metzinger & J. Windt (Eds.), *Open MIND*, Cambridge, Massachussetts: The MIT Press.

Gallese, V. and Keysers, C. (2001) Mirror neurons: A sensorimotor representation system. *Behavioral and Brain Sciences*, Vol. 24, 5, pp. 983–984 https://doi.org/10.1017/S0140525X01340116

Gallese, V., & Lakoff, G. (2005). The brain's concepts. The role of sensory-motor system in conceptual knowledge. *Cognitive Neuropsychology*, 22(3), 455–479. https://doi.org/10.1080/02643290442000310

Gallese, V. (2008), Mirror neurons and the social nature of language: the neural exploitation hypothesis, *Soc Neurosci.* 3(3–4):317–333. doi: https://doi.org/10.1080/17470910701563608.

Gallese, V., & Sinigaglia, C. (2011). What is so special about embodied simulation?. *Trends Cogn Sci*, 15(11), 512–519. https://doi.org/10.1016/j.tics.2011.09.003

Gallistel, C. R., and King, A., (2009). *Memory and the Computational Brain*, Malden: Wiley-Blackwell. https://doi.org/10.1002/9781444310498

Gangitano, M., Mottaghy, F. M., & Pascual-Leone, A. (2001). Phase-specific modulation of cortical motor output during movement observation. *Neuroreport*, 12(7), 1489–1492. https://doi.org/10.1097/00001756-200105250-00038

Gastaut, H., & Bert, J. (1954). EEG changes during cinematographic presentation: moving picture activation of the EEG. *Electroencephalogr Clin Neurophysiol*. 6, 433–444. https://doi.org/10.1016/0013-4694(54)90058-9

Gentner, D. & Grudin, J. (1985). The evolution of mental Metaphors in psychology: A 90-year retrospective. *American Psychologist*, 40, 181–192. https://doi.org/10.1037/0003-066X.40.2.181

Gentner, D. Imai, & Boroditsky, L. (2002). As time goes by: Understanding time as spatial metaphor. *Language and Cognitive Processes*, 17, 537–565.

Gentner, D., and Brian, B.. 2008. *Metaphor as structure-mapping*. In Gibbs, R.W.. (Ed.), *The Cambridge handbook of metaphor and thought*, pp. 109–128.Cambridge, MA: Cambridge University Press.

Gentner, D., Imai M., & Boroditsky, L. (2002). As time goes by: Understanding time as spatial metaphor. *Language and Cognitive Processes*, 17, 537–565. https://doi.org/10.1080/01690960143000317

Gentner, D., & Kurtz, K. (2006). Relations, objects, and the composition of analogies. *Cognitive Science*, 30, 609–642. https://doi.org/10.1207/s15516709cog0000_60

Gernsbacher, M., & Faust, M. (1991). The mechanism of suppressional component of general comprehension skill. *J. Exp. Psychol. Learn. Mem. Cogn*. 17, 245–262. https://doi.org/10.1037/0278-7393.17.2.245

Gernsbacher, M., & Robertson, R. (1995). Reading skill and suppression revisited. *Psychol. Sci*. 6, 165–169. https://doi.org/10.1111/j.1467-9280.1995.tb00326.x

J. Ghika, M. Tennis, J. Growdon, E. Hoffman, K. Johnson (1995). Environment-driven responses in progressive supranuclear palsy, *Journal of the neurological Sciences*, Volume 130, Issue 1, Pages 104–111.

Gibbs, R. W. (1991). Semantic analyzability in children's understanding of idioms. *Journal of Speech and Hearing Research*, 34, 613–620. https://doi.org/10.1044/jshr.3403.613

Gibbs, R. W. (1992). What do idioms really mean? *Journal of Memory and Language*, 31, 485–506. https://doi.org/10.1016/0749-596X(92)90025-S

Gibbs, R. W. (1994). *The poetics of mind: Figurative thought, language, and understanding*. New York, NY: Cambridge University Press.

Gibbs, R. W. (1999), *Intentions and the experience of meaning*. New York: Cambridge University Press.

Gibbs, R. W. (2003). Embodied meanings in performing, interpreting and talking about dance improvisation. In C. Albright and D. Gere (Eds.), *Taken by surprise: A dance improvisation reader* (pp. 185–196). Middletown, CT: Wesleyan University Press.

Gibbs, R. W. (2005). The psychological status of image schemas. In B. Hampe (Ed.), *From Perception to Meaning: Image-Schemas in cognitive linguistics* (pp. 113–130). Berlin: Mouton. https://doi.org/10.1515/9783110197532.2.113

Gibbs, R. W. (2006a). Metaphor interpretation as embodied simulation. *Mind and Language*, 21, 434–458.

Gibbs, R. W. (2006b). *Embodiment and Cognitive Science*. Cambridge: Cambridge University Press.

Gibbs, R. W. (2007). Why cognitive linguists should care more about empirical methods. In M. Gonzalez-Marquez, I. Mittelberg, S. Coulson, & M. J. Spivey (Eds.). *Methods in Cognitive Linguistics* (pp. 2–118). Amsterdam: John Benjamins. https://doi.org/10.1075/hcp.18.06gib

Gibbs, R. W. (Ed.) (2008). *The Cambridge handbook of metaphor and thought*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511816802

Gibbs, R. W. (2011a). Are 'deliberate' metaphors really deliberate? A question of human consciousness and action. *Metaphor and the Social* World, 1(1), 26–52. https://doi.org/10.1075/msw.1.1.03gib

Gibbs, R. W. (2011b). Evaluating Conceptual Metaphor Theory. *Discourse Processes*, 48(8), 529–562. https://doi.org/10.1080/0163853X.2011.606103

Gibbs, R. W. (2014). Embodied metaphor, pp. 167–184. In J. Littlemore and J. R. Taylor (eds.). *The Bloomsbury companion to cognitive linguistics*, Bloomsbury, London: UK; Broadway: USA.

Gibbs, R. W. (2015a). Does deliberate metaphor theory have a future?. *Journal of Pragmatics*, 90, 73–76. https://doi.org/10.1016/j.pragma.2015.03.016

Gibbs, R. W. (2015b). Do pragmatic signals affect conventional metaphor understanding? A failed test of deliberate metaphor theory. *Journal of Pragmatics*, 90, 77–87. https://doi.org/10.1016/j.pragma.2015.05.021

Gibbs, R. W. (2017a). *Metaphor Wars*. Cambridge, UK: Cambridge University Press. https://doi.org/10.1017/9781107762350

Gibbs, R. W. (2017b). The embodied and discourse view of metaphor: Why these are not so different and how they can be brought closer together (319–334). In In B. Hampe (Ed.), *Metaphor: Embodied Cognition and Discourse* (pp. 27–45). Cambridge: Cambridge University Press. https://doi.org/10.1017/9781108182324.018

Gibbs, R. W. & Pelosi Silva de Macedo, A. C. (2010). Metaphor and Embodied Cognition. *D.E.L.T.A.*, 26, 679–700.

Gibson, J. J. (1979). *The Ecological Approach to Visual Perception*. Boston: Houghton- Mifflin.

Gibbs, R., & O'Brien, J. (1990). Idioms and mental imagery: The metaphorical motivation for idiomatic meaning. *Cognition*, 36, 35–68.

Gibbs, R., & Bogdonovich, J. (1999). Mental imagery in interpreting poetic metaphor. *Metaphor and Symbol*, 14, 37–44.

Gibbs, R., & Franks, H. (2002). Embodied metaphors in women's' narratives about their experiences with cancer. *Health Communication*, 14, 139–165.

Gibbs, R., Lima, P., & Francuzo, E. (2004). Metaphor is grounded in embodied experience. *Journal of Pragmatics*, 36, 1189–1210.

Gibbs, R., Gould, J., & Andric, M. (2006). Imagining metaphorical actions: Embodied simulations make the impossible plausible. *Imagination, Cognition, & Personality*, 25, 221–238.

Gibbs, R.W. Jr., and Cameron, L. (2008). The social-cognitive dynamics of metaphor performance. *Journal of Cognitive Systems Research*, 9(1–2), 64–75.

Gibbs, R., Bogdonovich, J., Sykes, J., & Barr, D. (1997). Metaphor in idiom comprehension. *Journal of Memory and Language*, 37, 141–154.

Giessner, S. R., & Schubert, T. W. (2007). High in the hierarchy: How vertical location and judgments of leaders' power are interrelated. *Organizational Behavior and Human Decision Processes*, 104, 30–44. https://doi.org/10.1016/j.obhdp.2006.10.001

Giora, R. (2003). *On Our Mind: Salience, Context, and Figurative Language*. Oxford/New York: Oxford University Press.

Giora, R. (2008). Is metaphor unique?. In R. W. Gibbs (Ed.), *The Cambridge Handbook of Metaphor and Thought* (pp. 143–160). Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511816802.010

Glenberg, A. M., & Kaschak, M. P. (2002). Grounding language in action. *Psychon Bull Rev*, 9(3), 558–565. https://doi.org/10.3758/BF03196313

Glenberg, A. M., Witt, J. K., & Metcalfe, J. (2013). From the Revolution to Embodiment: 25 Years of Cognitive Psychology. *Perspectives on Psychological Science*, 8, 573–585. https://doi.org/10.1177/1745691613498098

Glucksberg, S. (2001). *Understanding figurative language: From Metaphors to idioms*. New York, NY: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195111095.001.0001

Glucksberg, S. (2003).The psycholinguistics of Metaphors. *Trends Cogn. Sci.* 7, 92–96. https://doi.org/10.1016/S1364-6613(02)00040-2

Glucksberg, S. (2008). *How metaphors create categories – quickly*. In Gibbs, R.W. (Ed.), The Cambridge handbook of metaphor and thought, pp. 67–83.Cambridge, MA:Cambridge University Press.

Goldman, A. and de Vignemont, F. (2009), Is social cognition embodied?, *Trends Cogn Sci*. 2009 Apr;13(4):154–159. doi: https://doi.org/10.1016/j.tics.2009.01.007. Epub 2009 Mar 9.

Glucksberg, S., Brown, M., & McGlone, M. S. (1993). conceptual Metaphors are not automatically accessed during idiom comprehension. *Memory & Cognition*, 21, 711–719. https://doi.org/10.3758/BF03197201

Goatly, A. (1997). *The language of Metaphors*. New York, NY: Routledge. https://doi.org/10.4324/9780203210000

Goatly, A. (2007). *Washing the brain: Metaphor and hidden ideology*. Amsterdam: John Benjamins. https://doi.org/10.1075/dapsac.23

Goldman, A. (2009). Mirroring, Simulating and Mindreading. *Mind and Language*, 24, 235–252. https://doi.org/10.1111/j.1468-0017.2008.01361.x

Goldman, A. (2012). A moderate approach to embodied cognitive science. *Review of Philosophy and Psychology* 3 (1): 71–88. https://doi.org/10.1007/s13164-012-0089-0

Goldman, A. (2013). The bodily formats approach to embodied cognition. In U. Kriegel (Ed.), *Current controversies in philosophy of mind* (pp. 91–108). London: Routledge.

Goldman, A. & de Vignemont, F. (2009). Is social cognition embodied?, *Trends in Cognitive Sciences*, 13 (4) :154–159

Goldstein, A., Arzouan, Y., & Faust, M. (2012). Killing a novel metaphor and reviving a dead one: ERP correlates of metaphor conventionalization. *Brain Lang.*, 123, 137–142. https://doi.org/10.1016/j.bandl.2012.09.008

Goldwasser, O. (2005). Where is metaphor? Conceptual metaphor and alternative classification in the hieroglyphic script. *Metaphor and Symbol*, 20, 95–113. https://doi.org/10.1207/s15327868ms2002_1

Gong, S. -P., & Ahrens, K. (2007). Processing conceptual Metaphors in ongoing discourse. *Metaphor and Symbol*, 22, 313–330. https://doi.org/10.1080/10926480701528121

Grady, J. (1997a). Theories are building revisited. *Cognitive Linguistics*, 8(4), 267–290. https://doi.org/10.1515/cogl.1997.8.4.267

Grady, J. (1997b). *Foundations of Meaning: Primary Metaphors and Primary Scenes*. Ph.D. dissertation, University of California, Berkeley.

Grady, J. (1999). A typology of motivation for conceptual metaphor: correlation vs. resemblance. In G. Steen & R. Gibbs (Eds.), *Metaphor in Cognitive Linguistics* (pp. 79–100). Philadelphia: John Benjamins. https://doi.org/10.1075/cilt.175.06gra

Grady, J. (2005). Primary Metaphors as inputs to conceptual integration. *Journal of Pragmatics*, 37, 1595–1614. https://doi.org/10.1016/j.pragma.2004.03.012

Grady, J., & Ascoli, G. (2017). Sources and Targets in Primary Metaphor Theory: Looking Back and Thinking Ahead. In B. Hampe (Ed.), *Metaphor: Embodied Cognition and Discourse* (pp. 27–45). Cambridge: Cambridge University Press. https://doi.org/10.1017/9781108182324.003

Grady, J., & Johnson, C. (1997). Converging Evidence for the Notions of subscene and primary scene (123–136). *Proceedings of the Twenty-Third Annual Meeting of the Berkeley Linguistics Society*. https://doi.org/10.3765/bls.v23i1.1258

Graziano, M. (2013). *Consciousness and the social brain*. Oxford: Oxford University Press

Grezes, J., Armony, J. L., Rowe, J., & Passingham, R. E. (2003). Activations related to "mirror" and "canonical" neurons in the human brain: an fMRI study. *Neuroimage*, 18, 928–937. https://doi.org/10.1016/S1053-8119(03)00042-9

Grezes, J., & Decety, J. (2002). Does visual perception of object afford action? Evidence from a neuroimaging study. *Neuropsychologia*, 40, 212–222. https://doi.org/10.1016/S0028-3932(01)00089-6

Haggard, P., & Wolpert, D. M. (2005). Disorders of Body Scheme. In H. J. Freund, M. Jeannerod, M. Hallett & R. Leiguarda (Eds.), *Higher-Order Motor Disorders* (pp. 261–271). Oxford: Oxford University Press.

Hagoort, P., Hald, L. A., Bastiaansen, M. C. M., & Petersson, K. M. (2004). Integration of word meaning and world knowledge in language comprehension. *Science*, 304, 438–441. https://doi.org/10.1126/science.1095455

Hampe, B. (2005). *From Peception to Meaning: Image-Schemas in Cognitive Linguistics*. Berlin: Mouton. https://doi.org/10.1515/9783110197532

Hampe, B. (2017). *Metaphor: Embodied Cognition and Discourse*. Cambridge: Cambridge University Press. https://doi.org/10.1017/9781108182324

Hahne A., & Friederici A. D. (2002). Differential task effects on semantic and syntactic processes as revealed by ERPs. *Cogn Brain Res*, 13, 339–356. https://doi.org/10.1016/S0926-6410(01)00127-6

Hahne A., & Friederici A. D. (1999). Electrophysiological evidence for two steps in syntactic analysis: early automatic and late controlled processes. *J Cogn Neurosci*, 11, 194–205. https://doi.org/10.1162/089892999563328

Hauser, M., Chomsky, N., & Fitch, W. T. (2002). The language faculty: What is it, who has it, and how did it evolve? *Science*, 298, 1569–1579.

Hari, R., Forss, N., Avikainen, S., Kirveskari, E., Salenius, S., & Rizzolatti, G. (1998). Activation of human primary cortex during action observation: a neuromagnetic study. *Proc Natl Acad Sci USA*, 95, 15061–15065. https://doi.org/10.1073/pnas.95.25.15061

Haser, V. (2005). *Metaphor, metonymy, and experientialist philosophy: Challenging cognitive semantics*. Berlin: Mouton. https://doi.org/10.1515/9783110918243

Haugeland, J. (1991). Representational genera. In W. Ramsey, S. Stich & D. Rumelhart (Eds.), *Philosophy and Connectionist Theory* (pp. 61–90). Hillsdale, NJ: Erlbaum.

Hebb, D. O. (1949). *The organization of behaviour; a neuropsychological theory*. New York: Wiley.

Held, R. & Hein A. (1963). Movement-produced stimulation in the development of visually guided behavior. *Jouranal of Comparative and Physiological Psychology*, 56(5), 872–876. https://doi.org/10.1037/h0040546

Holst von, E., Mittelstaedt, H., (1950). The reafference principle: interaction between the central nervous system and the periphery. *Die Naturwissenschaften*, 37, 464–476.

Hohwy, J. (2014). *The Predictive Mind*. Oxford: Oxford University Press.

Hummel, F., Andres, F., Alenmuller, E., Dichgans, J., & Gerloff, C. (2002). Inhibitory control of acquired motor programmes in the human brain. *Brain*, 125, 404–420. https://doi.org/10.1093/brain/awf030

Humphreys, G. W., Riddoch, M. J. (2001) Detection by action: neuropsychological evidence for action-defined templates in search. *Nat Neurosci*, 4, 84–88. https://doi.org/10.1038/82940

Hutto, D. D., Myin, E. (2013). *Radicalizing enactivism. Basic minds without content*. Cambridge, Massachusetts: The MIT Press.

Hutto, D. D., Myin, E. (2017). *Evolving Enactivism Basic Minds Meet Content*. Cambridge, Massachusetts: The MIT Press.

Hutto, D. D., & Satne, G. (2015). The Natural Origins of Content. *Philosophia*, 43(3). https://doi.org/10.1007/s11406-015-9644-0

Iacoboni, M. (2003). Understanding others: imitation, language, empathy. In S. Hurley, & N. Chater (Eds.), *Perspectives on imitation: from cognitive neuroscience to social science* (pp. 77–100). Cambridge, Massachusetts: The MIT Press.

Ibbotson, P., Lieven, E. V., & Tomasello, M. (2013). The attention-grammar interface: eye-gaze cues structural choice in children and adults. *Cognitive Linguistics*, 24(3), 457–481. https://doi.org/10.1515/cog-2013-0020

Ijzerman, H. & G.R. Semin. (2009). The thermometer of social relations mapping social proximity on temperature. *Psychological Science* 20(10). 1214–1220.

Jacob, P. (2008). What do Mirror Neurons Contribute to Human Social Cognition?. *Mind and Language*, 23, 190–223.

Jackendoff, R. (1983). *Semantics and cognition*. Cambridge, Massachusetts: The MIT Press.

Jakel, O. (1999). Kant, Blumenberg, Weinrich. Some forgotten contributions to the cognitive theory of metaphor. In R. Gibbs, & G. Steen *Metaphor in cognitive linguistics* (pp. 9–56). Amsterdam: John Benjamins. https://doi.org/10.1075/cilt.175.02jak

Johnson, M. (1987). *The body in the mind: the bodily basis of meaning, imagination, and reason*. Chicago: University of Chicago Press.

Johnson, M. (1993). *Moral imagination: Implications of cognitive science for ethics*. Chicago, IL: University of Chicago Press.

Johnson, C. 1999. Metaphor vs. conflation in the acquisition of polysemy: The case of SEE. In M. K. Hiraga, C. Sinha, and S. Wilcox, (Eds.), *Cultural, typological and psychological issues in cognitive linguistics. Current Issues in Linguistic Theory*, vol. 152, pp. 155–169. Amsterdam: John Benjamins.

Johnson, M. (2005). The Philosophical Significance of Image Schemas. In B. Hampe (Ed.), *From Perception to Meaning: Image Schemas in Cognitive Linguistics* (pp. 15–33). Berlin: Mouton de Gruyter. https://doi.org/10.1515/9783110197532.1.15

Johnson, M. & Larsen, S. (2003). Something in the way she moves. *Metaphor and Symbol*, 18, 63–84. https://doi.org/10.1207/S15327868MS1802_1

Johnson, M. (2017). *Embodied Mind, Meaning and reasoning*. Chicago: The University of Chicago Press. https://doi.org/10.7208/chicago/9780226500393.001.0001

Jonides, J. (1981). Voluntary versus automatic control over the mind's eye's movement. *Attention and performance*, 9(9), 187–203.

Jostmann, N. B., Lakens, D. & Schubert, T. W. (2009). Weight as an embodiment of importance. *Psychological Science*, 20(9), 1169–1174. https://doi.org/10.1111/j.1467-9280.2009.02426.x

Katz, A., & Ferratti, T. (2001). Moment-by-moment comprehension of proverbs in discourse. *Metaphor and Symbol*, 11, 17–37. https://doi.org/10.1207/s15327868ms1101_2

Katz, A., & Taylor, T. (2008). The journeys of life: Examining a conceptual metaphor with semantic and episodic memory recall. *Metaphor and Symbol*, 23, 148–173. https://doi.org/10.1080/10926480802223051

Kelso, J. A. S. (1995). *Dynamic patterns: the self-organization of brain and behavior*. Cambridge, Massachusetts; London: The MIT Press.

Kemmerer, D., Castillo J. G., Talavage, T., Patterson, S., & Wiley, C. (2008). Neuroanatomical distribution of five semantic components of verbs: evidence from fMRI. *Brain Lang*, 107(1), 16–43. https://doi.org/10.1016/j.bandl.2007.09.003

Kertész, A., C. Rákosi (2009), Cyclic vs. circular argumentation in the Conceptual Metaphor Theory. *Cognitive Linguistics* 20: 703–732. https://doi.org/10.1515/COGL.2009.030

Kessler, K., Biermann-Ruben, K., Jonas, M., Siebner, H. R., Baeumer, T., Muenchau, A., & Schnitzler, A. (2006). Investigating the human mirror neuron system by means of cortical synchronization during the imitation of biological movements. *Neuroimage*, 33, 227–238. https://doi.org/10.1016/j.neuroimage.2006.06.014

Keysar, B., & Bly, B. (1995). Intuitions of the transparency of idioms: Can one keep a secret by spilling the beans?. *Journal of Memory and Language*, 34, 89–109. https://doi.org/10.1006/jmla.1995.1005

Keysar, B., Shen, Y., Glucksberg, S., & Horton, W. (2000). Conventional language: How metaphoric is it?. *Journal of Memory and Language*, 43, 576–593. https://doi.org/10.1006/jmla.2000.2711

Kilner, J. M., Marchant, J. L., & Frith, C. D. (2006). Modulation of the mirror system by social relevance. *Scan*, 1, 143–148.

Kintsch, W. (1998). *Comprehension: A paradigm for cognition*. Cambridge: Cambridge University Press.

Kintsch, W. (2000). Metaphor comprehension: a computational theory. *Psychon. Bull. Rev*. 7, 257–266. https://doi.org/10.3758/BF03212981

Kintsch, W. (2001). Predication. *Cogn. Sci*. 25, 173–202. https://doi.org/10.1207/s15516709cog2502_1

Kintsch, W., & Bowles, A. (2002). Metaphor comprehension: what makes a metaphor difficult to understand?. *Metaphor & Symbol*. 17, 249–262. https://doi.org/10.1207/S15327868MS1704_1

Kohler, W. (1969). *The task of gestalt psychology*. NJ: Princeton University Press.

Kilner, J. M., & Friston, K. J., Frith, C. D. (2007). Predictive coding: an account of the mirror neuron system. *Cogn Process*, 8, 159–166. https://doi.org/10.1007/s10339-007-0170-2

Koller, V. (2004). *Metaphor and gender in business media discourse: A critical cognitive study*. Basingstoke, UK: Palgrave. https://doi.org/10.1057/9780230511286

Kövecses, Z. (2000). *Metaphor and emotion*. New York, NY: Cambridge University Press.

Kövecses, Z. (2002). *Metaphor: A practical introduction*. New York, NY: Oxford University Press.

Kövecses, Z. (2003). Language, figurative thought, and cross-cultural comparison. *Metaphor and Symbol*, 18, 311–320. https://doi.org/10.1207/S15327868MS1804_6

Kövecses, Z. (2005a). *Metaphor in Culture. Universality and Variation*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511614408

Kövecses, Z. (2005b). Metaphor and Culture. *Acta Universitatis Sapientiae, Philologica*, 2(2), 197–220.

Kövecses, Z. (2006). *Language, mind, and culture: A practical introduction*. New York, NY: Oxford University Press.

Kövecses, Z. (2008). Conceptual metaphor theory: Some criticisms and alternative proposals. *Annual Review of Cognitive Linguistics*, 6, 168–184. https://doi.org/10.1075/arcl.6.08kov

Kövecses, Z. (2009). Metaphor, culture, and discourse: The pressure of coherence. In J. Zinken, & A. Musolff (Eds.), *Metaphor in discourse* (pp. 11–24). Amsterdam: John Benjamins. https://doi.org/10.1057/9780230594647_2

Kövecses, Z. (2010). *Metaphor: A practical introduction*. Second edition. New York, NY: Oxford University Pres

Kövecses, Z. (2015). *Where Metaphors Come From. Reconsidering Context in Metaphor*. Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780190224868.001.0001

Kriegel, U. (2013). Two Notions of Mental Representation. In U. Kriegel (Ed.), *Current Controversies in Philosophy of Mind* (pp. 161–179). New York and London: Routledge.

Kutas, M., & Federmeier, K. D. (2011). Thirty years and counting: Finding meaning in the N400 component of the event-related brain potential (ERP). *Annual Review of Psychology*, 62, 621–647. https://doi.org/10.1146/annurev.psych.093008.131123

Lai, V., & Curran, T. (2013). ERP evidence for conceptual mappings and comparison processes during the comprehension of conventional and novel Metaphors. *Brain & Language*, 127(2), 484–496.

Lakoff, G. (1987). *Women, fire, and dangerous things: what categories reveal about the mind*. Chicago: University of Chicago Press. https://doi.org/10.7208/chicago/9780226471013.001.0001

Lakoff, G. (1990). The invariance hypothesis: Is abstract reason based on image-schemas?. *Cognitive Linguistics*, 1, 39–74.

Lakoff, G. (1993). The contemporary theory of metaphor. In A. Ortony (Ed.), *Metaphor and thought*: *Vol.* 2 (pp. 202–251). New York, NY: Cambridge University Press. https://doi.org/10.1017/CBO9781139173865.013

Lakoff, G. (1995). Steps Toward a Neurocognitive Self: Conceptual System Research in the 21st Century And Its Role in Rethinking What a Person Is. In Dom Massaro and Robert Solso (eds.), *The Science of the Mind; 2001 and Beyond*. Oxford: Oxford University Press, 1995.

Lakoff, G. (1996). *Moral politics*. Chicago, IL: University of Chicago Press.

Lakoff, G. (2002). *Moral Politics: How Liberals and Conservatives Think*. Chicago: University of Chicago Press. https://doi.org/10.7208/chicago/9780226471006.001.0001

Lakoff, G. (2008). The Neural Theory of Metaphor. In R. Gibbs (Ed.), *The Cambridge handbook of metaphor and thought* (pp. 17–38). New York: Cambridge University Press. https://doi.org/10.1017/CBO9780511816802.003

Lakoff, G. (2014). Mapping the Brain's metaphor circuitry: Is abstract thought metaphorical thought?. *Frontiers in Human Neuroscience*, 16(8), 958. https://doi.org/10.3389/fnhum.2014.00958

Lakoff, G., & Johnson, M. (1980). *Metaphors We Live By*. Chicago and London: University of Chicago Press.

Lakoff, G., & Johnson, M. (1999). *Philosophy in the Flesh: The Embodied Mind and Its Challenge to Western Thought*. New York: Basic Books.

Lakoff, G., & Núñez, R. (2000). *Where mathematics comes from: How the embodied mind brings mathematics into being*. New York, NY: Basic Books.

Lakoff, G., & Turner, M. (1989). *More than cool reason: A field guide to poetic metaphor*. Chicago, IL: University of Chicago Press. https://doi.org/10.7208/chicago/9780226470986.001.0001

Langacker, R. W. (1987). *Foundations of cognitive grammar*, vol. 1: *Theoretical prerequisites*. Stanford, CA: Stanford University Press.

Langacker, R. W. 1991. *Foundations of cognitive grammar*, vol. 2: *Descriptive application*. Stanford, CA: Stanford University Press.

Langston, W. (2002). Violating orientational Metaphors slows reading. *Discourse Processes*, 34, 281–310.

Larson, B., Nerlich, B., & Wallis, P. (2006). Metaphor and biorisks. *Science Communication*, 26, 243–268. https://doi.org/10.1177/1075547004273019

Landau, Mark J., Brian P. Meier & Lucas A. Keefer. (2010). A metaphor-enriched social cognition. *Psychological Bulletin* 13(6). 1045–1067.

Lebois, L. A. M., Wilson-Mendenhall, C. D., & Barsalou, L. W. (2010). Are Automatic Conceptual Cores the Gold Standard of Semantic Processing? The Context-Dependence of Spatial Meaning in Grounded Congruency Effects. *Cognitive Science*, 39(8), 1764–1801. https://doi.org/10.1111/cogs.12174

Leezenberg, M. (2009), From Cognitive Linguistics to Social Science: Thirty Years after Metaphors We Live By,*Cognitive Semiotics*, Volume 5, Issue 1–2, Pages 140–152, ISSN (Online) 2235–2066.

Lee, S. W. S., & Schwarz, N. (2012). Bidirectionality, mediation, and moderation of metaphorical effects: The embodiment of social suspicion and fishy smells. *Journal of Personality and Social Psychology*, 103(5), 737–749. https://doi.org/10.1037/a0029708

Leenzeberg, M. (2009). From Cognitive Linguistics to Social Science: Thirty Years after Metaphors We Live By. *Cognitive Semiotics*, 5(1–2), 140–152.

Levine, J. (1983). Materialism and Qualia: The Explanatory Gap. *Pacific Philosophical Quarterly*, 64(4), 354–361. https://doi.org/10.1111/j.1468-0114.1983.tb00207.x

Lhermitte, F. (1986). Human autonomy and the frontal lobes. Part II: Patient behavior in complex and social situations: the 'environmental dependency syndrome'. *Ann Neurol*, 19(4), 335–343. https://doi.org/10.1002/ana.410190405

Lopez, C. (2016). The vestibular system: balancing more than just the body. *Curr Opin Neurol.*, 29(1), 74–83. https://doi.org/0.1097/WCO.0000000000000286

Maalej, Z. (2004). Figurative language in anger expressions in Tunisian Arabic: An extended view of embodiment. *Metaphor and Symbol*, 19(1), 51–75. https://doi.org/10.1207/S15327868MS1901_3

Macnamara, D. S., & Magliano, J. (2009). Toward a comprehensive model of comprehension. In B. Ross (Ed.), *The Psychology of Learning and Motivation*, *Vol.* 51 (pp. 297–384). Burlington, VT, USA: Academic Press. https://doi.org/10.1016/S0079-7421(09)51009-2

Maeda, F., Kleiner-Fisman, G., & Pascual-Leone, A. (2002). Motor facilitation while observing hand actions: specificity of the effect and role of observer's orientation. *J Neurophysiol*, 87(3), 1329–1335. https://doi.org/10.1152/jn.00773.2000

Maidhof, C., & Koelsch, S. (2011). Effects of selective attention on syntax processing in music and language. *Journal of Cognitive Neuroscience*, 23(9), 2252–2267. https://doi.org/10.1162/jocn.2010.21542

Martin, J. (1990). *A computational model of metaphor interpretation*. San Diego, CA: Academic.

Mashal, N. (2013). The role of working memory in the comprehension of unfamiliar and familiar Metaphors. *Lang. Cogn*. 5, 409–436. https://doi.org/10.1515/langcog-2013-0024

Mashal, N., & Faust, M. (2009). Conventionalization of novel Metaphors: a shift in hemispheric asymmetry. *Laterality* 14, 573–589. https://doi.org/10.1080/13576500902734645

Mason, Z. (2004). CorMet: A computational, corpus-based conventional metaphor extraction system. *Computational Linguistics*, 30, 23–44.

Matlock, T., Ramscar, M., & Boroditsky, L. (2005). The experiential link between spatial and temporal language. *Cognitive Science*, 29, 655–664. https://doi.org/10.1207/s15516709cog0000_17

McGlone, M. (1996). conceptual Metaphors and figurative language interpretation: Food for thought? *Journal of Memory and Language*, 35, 544–565. https://doi.org/10.1006/jmla.1996.0029

McGlone, M. (2007). What is the explanatory value of a conceptual metaphor? *Language & Communication*, 27, 109–126. https://doi.org/10.1016/j.langcom.2006.02.016

McGlone, M., & Harding, J. (1998). Back (or forward?) to the future: The role of perspective in temporal language comprehension. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, 24, 1211–1223.

McNeill, D. (1992). *Hand in mind*. Chicago, IL: University of Chicago Press.

Meier, B. P., & Robinson, M. D. (2004). Why the sunny side is up. *Psychological Science*, 15, 243–247. https://doi.org/10.1111/j.0956-7976.2004.00659.x

Meier, B. P., Robinson, M. D., & Clore, G. L. (2004). Why good guys wear white: Automatic inferences about stimulus valence based on brightness. *Psychological Science*, 15, 82–87. https://doi.org/10.1111/j.0963-7214.2004.01502002.x

Meier, B. P., Robinson, M. D., Crawford, L. E., & Ahlvers, W. J. (2007). When "light" and "dark" thoughts become light and dark responses: Affect biases brightness judgments. *Emotion*, 7, 366–376. https://doi.org/10.1037/1528-3542.7.2.366

Meltzoff, A. N., & Moore, M. K. (1977). Imitation of facial and manual gestures by human neonates. *Science*, 198(4312), 75–78. https://doi.org/10.1126/science

Meltzoff, A. N., & Moore, M. K. (1983). Newborn infants imitate adult facial gestures. *Child Dev*, 54(3), 702–709. https://doi.org/10.2307/1130058

Meltzoff, A. N., & Moore, M. K. (1989). Imitation in Newborn Infants: Exploring the Range of Gestures Imitated and the Underlying Mechanisms. *Dev Psychol*, 25(6), 954–962. https://doi.org/10.1037/0012-1649.25.6.954

Merleau-Ponty, M. (1945). *Phénoménologie de la perception*. Paris: Gallimard.

Meteyard, L., Cuadrado, S. R., Bahrami, B., & Vigliocco, G. (2012). Coming of age: a re-view of embodiment and the neuroscience of semantics. *Cortex*, 48(7), 788–804. https://doi.org/10.1016/j.cortex.2010.11.002

Miall, R. C. (2003), Connecting mirror neurons and forward models, *Neuroreport*, Vol 14 No 16, pp. 1–3.

Miall, R. C., & Wolpert, D. M. (1996). Forward models for physiological motor control. *Neural Networks*, 9, 1265–1279. https://doi.org/10.1016/S0893-6080(96)00035-4

Miles, L. K., Nind, L. K. & Macrae, C. N. (2010). Moving through time. *Psychological Science* 21, 222–223. https://doi.org/10.1177/0956797609359333

Millikan, R. G. (1984). *Language, thought and other biological catagories: new foundations for realism*. Cambridge, Massachusetts; London: The MIT Press.

Mishra, R. K. (2015a). *Interaction Between Attention and Language System in Humans*. New Delhi: Springer. https://doi.org/10.1007/978-81-322-2592-8

Mishra, R. K. (2015b). Listening through the native tongue: A review essay on Cutler's Native listening: Language experience and the recognition of poken words. *Philosophical Psychology*, 28(7), 1–15. https://doi.org/10.1080/09515089.2014.896697

Miyake, A., Just, M., & Carpenter, P. (1994). Working-memory constraints on the resolution of lexical ambiguity: maintaining multiple interpretations in neutral contexts. *J. Mem. Lang.* 33, 175–202. https://doi.org/10.1006/jmla.1994.1009

Montijn, J. S., Vinck, M., & Pennartz, C. M. (2014). Population coding in mouse visual cortex: response reliability and dissociability of stimulus tuning and noise correlation. *Front Comput Neurosci*, 8, 58. https://doi.org/10.3389/fncom.2014.00058

Murphy, G. (1996). On metaphoric representations. *Cognition*, 60, 173–204. https://doi.org/10.1016/0010-0277(96)00711-1

Musolff, A. (2004). *Metaphor and political discourse: Analogical reasoning in debates about Europe*. London, England: Palgrave-Macmillan. https://doi.org/10.1057/9780230504516

Muthukumaraswamy, S. D., Johnson, B. W. (2004). Changes in rolandic mu rhythm during observation of a precision grip. *Psychophysiology*, 41, 152–156. https://doi.org/10.1046/j.1469-8986.2003.00129.x

Muthukumaraswamy, S. D., Johnson, B. W., McNair, N. A. (2004). Mu rhythm modulation during observation of an object-directed grasp. *Brain Res Cogn Brain Res*, 19, 195–201. https://doi.org/10.1016/j.cogbrainres.2003.12.001

Nagel, E. (1949). The meaning of reduction in the natural sciences. In R. C. Stauffer (Ed.), *Science and civilization* (pp. 99–138). Madison: University of Wisconsin Press.

Narayanan, S. (1997). *Moving right along: A computational model of metaphoric reasoning about events*. Unpublished Ph.D. dissertation, International Computer Science Institute, University of California, Berkeley.

Nayak, N., & Gibbs, R. (1990). Conceptual knowledge in the interpretation of idioms. *Journal of Experimental Psychology: General*, 119, 315–330. https://doi.org/10.1037/0096-3445.119.3.315

Neisser, U. (1987). *Concepts and conceptual development: Ecological and intellectual factors in categorization*. New York: Cambridge University Press.

Neuper, C., Scherer, R., Wriesnegger, S., & Pfurtscheller, G. (2009). Motor imagery and action observation: modulation of sensorimotor brain rhythms during mental control of a brain-computer interface. *Clin Neurophysiol*, 120, 239–247. https://doi.org/10.1016/j.clinph.2008.11.015

Niedenthal, P. M., Barsalou, L. W., Winkielman, P., Krauth-Gruber, S., & Ric, F. (2005). Embodiment in attitudes, social perception, emotion, *Pers Soc Psychol Rev*, 9(3), 184–211. https://doi.org/10.1207/s15327957pspr0903_1

Nishitani, N., Hari, R. (2000). Temporal dynamics of cortical representation for action. *Proc Natl Acad Sci USA*, 97, 913–918. https://doi.org/10.1073/pnas.97.2.913

Niziolek, C. A., Nagarajan, S. S., & Houde, J. F. (2013). What does motor efference copy represent? Evidence from speech production. *J Neurosci*, 33(41), 16110–16116. https://doi.org/10.1523/JNEUROSCI.2137-13.2013

Noë, A. (2004). *Action in perception*. Cambridge, Massachusetts; London: The MIT Press.

Núñez, R., Motz, B., & Teuscher, U. (2006). Time after time: The psychological reality of the ego- and time–reference–point distinction in metaphorical contruals of time. *Metaphor and Symbol*, 21, 133–146. https://doi.org/10.1207/s15327868ms2103_1

Núñez, R., & Sweetser, E. (2006). With the future behind them: Convergent evidence from Aymara language and gesture in the crosslinguistic comparison of spatial construals of time. *Cognitive Science*, 30, 401–450. https://doi.org/10.1207/s15516709cog0000_62

Oberman, L. M., Ramachandran, V. S., Pineda, J. A. (2008). Modulation of mu suppression in children with autism spectrum disorders in response to familiar or unfamiliar stimuli: the mirror neuron hypothesis. *Neuropsychologia*, 46, 1558–1565. https://doi.org/10.1016/j.neuropsychologia.2008.01.010

Orton, S. (2004). Conceptual metaphor in the archaeological record: Methods and an example from the American Southwest. *American Antiquity*, 65, 613–645. https://doi.org/10.2307/2694419

Ortony, A. (1979). *Metaphor and thought*. Cambridge: Cambridge University Press.

Ozcaliskan, S. (2003). In a caravanserai with two doors I am walking day and night: Metaphors of death and life in Turkish. *Cognitive Linguistics*, 14, 281–320. https://doi.org/10.1515/cogl.2003.012

Paillard, J. (1999). Body schema and body image – a double dissociation in deafferented patients. In G. N. Gantchev, S. Mori, & J. Massion (Eds.), *Motor control: today and tomorrow* (pp. 197–214). Academic Publishing House: Sofia, Bulgaria.

Paillard, J. (2005). Vectorial versus configural encoding of body space. A neural basis for a distinction between Body schema and Body Image. In H. De Preester & V. Knockaert (Eds.), *Body Image and Body schema: Interdisciplinary perspectives on the body* (pp. 89–109). Amsterdam: John Benjamins. https://doi.org/10.1075/aicr.62.07pai

Papeo, L., Rumiati, R. I., Cecchetto, C., & Tomasino, B. (2012) On-line changing of thinking about words: the effect of cognitive context on neural responses to verb reading. *J Cogn Neurosci*, 24, 2348–2362. https://doi.org/10.1162/jocn_a_00291

Papeo, L., Vallesi, A., Isaja, A., & Rumiati, R. I. (2009). Effects of TMS on different stages of motor and non-motor verb processing in the primary motor cortex. *PLoS One*, 4(2): e4508. https://doi.org/10.1371/journal.pone.0004508

Papineau, D. (1993). *Philosophical naturalism*. Oxford: Blackwell.

Pauen, M. (2012). The second person perspective. *Inquiry*, 55(1), 33–49. https://doi.org/10.1080/0020174X.2012.643623

Pelosi, A. C. (2007). A psycholinguistic analysis of the metaphor "difficulties are weights". *Linguagem en (Dis)curso – LemD*, 7(3), 389–404.

Pexman, P., Ferratti, T., & Katz, A. (2000). Discourse factors that influence the online reading of metaphor and irony. *Discourse Processes*, 29, 201–222. https://doi.org/10.1207/S15326950dp2903_2

Pfaff, K., Gibbs, R., & Johnson, M. (1997). Metaphor in using and understanding euphemism and dysphemism. *Applied Psycholinguistics*, 18, 59–83. https://doi.org/10.1017/S0142716400009875

Pfurtscheller, G., Brunner, C., Schlogl, A., da Silva F. H. L. (2006). Mu rhythm desynchronisation and EEG single-trial classification of different motor imagery tasks. *Neuroimage*, 31, 153–159. https://doi.org/10.1016/j.neuroimage.2005.12.003

Phillips, B., & McQuarrie, E. (2007). Road map or secret weapon: The role of conceptual metaphor in shaping marketing communications about exercise. In T. Lowrey (Ed.), *Psycholinguistic phenomena in marketing communication* (pp. 135–154). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Piaget, J. (1971). *Biology and Knowledge*. Chicago: University of Chicago Press.

Pineda, J. A., & Hecht, E. (2009). Mirroring and mu rhythm involvement in social cognition: are there dissociable subcomponents of theory of mind?. *Biol Psychol*, 80, 306–314. https://doi.org/10.1016/j.biopsycho.2008.11.003

Pinker, S. (2007). *The stuff of thought*. New York, NY: Basic Books.

Port, R. F., & Van Gelder, T. (1995). *Mind as motion: explorations in the dynamics of cognition*. Cambridge, Massachusetts; London: The MIT Press.

Pellegrino di, G., Fadiga, L., Fogassi, L., Gallese, V., & Rizzolatti, G. (1992). Understanding motor events: a neurophysiological study. *Exp Brain Res*, 91(1), 176–180. https://doi.org/10.1007/BF00230027

Pragglejaz Group. (2007). MIP: A method for identifying metaphorically-used words in discourse. *Metaphor and Symbol*, 22, 1–40. https://doi.org/10.1080/10926480709336752

Pulvermüller, F. (1999). Words in the brain's language. *Behav Brain Sci*, 22(2), 253–279. https://doi.org/10.1017/S0140525X9900182X

Pulvermüller, F. (2012). Meaning and the brain: The neurosemantics of referential, in-teractive, and combinatorial knowledge. *Journal of Neurolinguistics*, 25(5), 423–459. https://doi.org/10.1016/j.jneuroling.2011.03.004

Pulvermüller, F., Shtyrov, Y., Hasting, A. S., & Carlyon, R. P. (2008). Syntax as a reflex: Neurophysiological evidence for early automaticity of grammatical processing. *Brain and Language*, 104(3), 244–253. https://doi.org/10.1016/j.bandl.2007.05.002

Purves, D., Augustine, G. J., Fitzpatrick, D., Hall, W. C., La Mantia, A. S., McNamara, J. O., & Williams, S. M. (Eds) (2004). *Neuroscience*. Third edition. Sunderland (MA): Sinauer Associates.

Putnam, H., (1960). Minds and Machines.*Journal of Symbolic Logic*, 57–80.

Pynn, L. K., & DeSouza, J. F. (2013). The function of efference copy signals: implications for symptoms of schizophrenia. *Vision Res*, 76, 124–133. https://doi.org/10.1016/j.visres.2012.10.019

Radden, G., & Panther, K. U., (Eds.) (1999). *Metonymy in thought and language*. Amsterdam: John Benjamins.

Refaie, E. E. (2003). Understanding visual metaphor: The example of newspaper cartoons. *Visual Communication*, 2(1), 75–95. https://doi.org/10.1177/1470357203002001755

Rakova, M. (2002). The philosophy of embodied realism: A high price to pay?. *Cognitive Linguistics*, 13(3), 215–244.

Ramsey, W. (2007). *Representation Reconsidered*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511597954

Raposo A., Moss H. E., Stamatakis E. A., Tyler L. K. (2009) Modulation of motor and premotor cortices by actions, action words and action sentences. *Neuropsychologia* 47: 388–396.

Read, S., Cesa, I., Jones, D., & Collins, N. (1990). When is the federal budget like a baby? Metaphor in political rhetoric. *Metaphor and Symbol*, 5, 125–149. https://doi.org/10.1207/s15327868ms0503_1

Recanati, F., (2004). *Literal meaning*. Cambridge: Cambridge University Press.

Reddy, M. J. (1979). The conduit metaphor: A case of frame conflict in our language about language. In A. Ortony (Ed.), *Metaphor and Thought* (pp. 284–310). Cambridge: Cambridge University Press.

Regier, T. P. (1992). *The acquisition of lexical semantics for spatial terms: a connectionist model of perceptual categorization*. PhD dissertation

Regier, T. (1996). *The human semantic potential*. Chicago: University of Chicago Press.

Reijnierse, W. G., Burgers, C., Krennmayr, T., and Steen, G. J. (2015). How viruses and beasts affect our opinions (or not): The role of extendedness in metaphorical framing. *Metaphor and the Social World* 5(2), 245–263.

Richardson, D., & Matlock, T. (2007). The integration of figurative language and static depictions: An eye-movement study of fictive motion. *Cognition*, 102, 129–138. https://doi.org/10.1016/j.cognition.2005.12.004

Riskind, J.H. 1983. Nonverbal expressions and the accessibility of life experience memories: A congruence hypothesis. *Social Cognition* 2(1). 62–86.

Ritchie, D. (2008). X IS A JOURNEY: embodied simulation in metaphor interpretation. *Metaphor and Symbol*, 23(3), 174–199. https://doi.org/10.1080/10926480802223085

Rizzolatti, G., Fabbri-Destro, M., & Cattaneo, L. (2009). Mirror neurons and their clinical relevance. *Nat Clin Pract Neurol*, 5(1), 24–34. https://doi.org/10.1038/ncpneuro0990

Rizzolatti, G., Sinigaglia, C., & Anderson, F. (2008). *Mirrors in the brain: how our minds share actions and emotions*. Oxford: Oxford University Press.

Robins, S., & Mayer, R. (2000). The metaphor framing effect: Metaphorical reasoning about text-based dilemmas. *Discourse Processes*, 30, 57–86. https://doi.org/10.1207/S15326950dp3001_03

Rothenberg, A. (2008). Rembrandt's creation of the pictorial metaphor of self. *Metaphor and Symbol*, 23(2), 108–129. https://doi.org/10.1080/10926480801944269

Ruiz de Mendoza Ibáñez, F. J., & Santibáñez Sáenz, F. (2003). Content and formal cognitive operations in construing meaning. *Italian Journal of Linguistics*, 15, 293–320.

Ruiz de Mendoza Ibáñez, F. J., & Mairal, U. (2007). High-level metaphor and metonymy in meaning construction. In G. Radden, K. Kopolke, M. Berg, & P. Siemund (Eds.), *Aspects of meaning construction* (pp. 33–51). Amsterdam: John Benjamins. https://doi.org/10.1075/z.136.05rui

Rumelhart, D. (1980). Schemata: The building blocks of cognition. In R. Spiro, B. Bruce, & W. Brewer (Eds.), *Theoretical issues in reading comprehension* (pp. 33–58). Hillsdale, NJ: Erlbaum.

Ruiz de Mendoza Ibáñez, F. J. & Santibáñez Sáenz, F. (2003). Content and formal cognitive operations in construing meaning. *Italian Journal of Linguistics*, 15, 293–320.

Salverda, A. P., & Altmann, G. (2011). Attentional capture of objects referred to by spoken language. *Journal of Experimental Psychology: Human Perception and Performance*, 37(4), 1122.

Sanford, D. (2008). Metaphor and phonological reduction in English idiomatic expressions. *Cognitive Linguistics*, 19, 585–604. https://doi.org/10.1515/COGL.2008.023

Santana, E., & De Vega, M. (2011). Metaphors are embodied, and so are their literal counterparts. *Frontiers in Psychology*, 2(90), 1–12.

Santiago, J., Lupiáñez, J., Pérez, E., & Funes, M. J. (2007). Time (also) flies from left to right. *Psychonomic Bulletin & Review*, 14, 512–516. https://doi.org/10.3758/BF03194099

Savitt, S. (1974). Rorty's Disappearance Theory. *Philosophical Studies*, 28, 433–436. https://doi.org/10.1007/BF00372905

Sbriscia-Fioretti, B., Berchio, C., Freedberg, D., Gallese, V., Umiltà, M. A. (2013). ERP modulation during observation of abstract paintings by Franz Kline. *PLoS One*, 9;8(10):e75241. https://doi.org/10.1371/journal.pone.0075241

Schnall, S., Benton, J., & Harvey, S. (2008). With a clean conscience: Cleanliness reduces the severity of moral judgments. *Psychological Science*, 19, 1219–1222. https://doi.org/10.1111/j.1467-9280.2008.02227.x

Schubert, T. W. (2005). Your highness: Vertical positions as perceptual symbols of power. *Journal of Personality and Social Psychology*, 89, 1–21. https://doi.org/10.1037/0022-3514.89.1.1

Schuch, S. E., Bayliss, A. P., Klein, C., & Tipper, S. P. (2010). Attention modulates motor system activation during action observation: Evidence for inhibitory rebound. *Experimental Brain Research*, 205(2), 235–249. https://doi.org/10.1007/s00221-010-2358-4

Schendan, H. E. and Ganis, G. (2012). Electrophysiological Potentials Reveal Cortical Mechanisms for Mental Imagery, Mental Simulation, and Grounded (Embodied) Cognition. *Frontiers in Psychology*, Vol. 3, article 329. https://doi.org/10.3389/fpsyg.2012.00329

Searle, J. R., (1980). Minds, Brains and programs. *Behavioral and Brain Sciences*, 3, 417–457. https://doi.org/10.1017/S0140525X00005756

Searle, J. R., Dennett, D. C., & Chalmers, D. J. (1997). *The mystery of consciousness*. New York: New York Review of Books.

Semino, E. (2010). Descriptions of pain, metaphor and embodied simulation. *Metaphor and Symbol*, 25(4), 205–226. https://doi.org/10.1080/10926488.2010.510926

Shapiro, L. (2014), *The Routledge Handbook of Embodied Cognition*. New York: Routledge.

Shapiro, L. (2011). *Embodied Cognition*. New York: Routledge Press.

Shapiro, L. (2013). When is cognition embodied? In U. Kriegel (Ed.), *Current controversies in philosophy of mind* (pp. 73–90). London: Routledge.

Sherman, G. D. & Clore, G. L. (2009). The color of sin. White and black are perceptual symbols of moral purity and pollution. *Psychological Science*, 20(8), 1019–1025. https://doi.org/10.1111/j.1467-9280.2009.02403.x

Shinohara, K. & Matsunaka, Y. (2009). Pictorial Metaphors of emotion in Japanese comics. In C. J. Forceville, & E. Urios-Aparisi (Eds.), *Multimodal Metaphor* (pp. 265–296). Berlin: Mouton de Gruyter.

Shtyrov, Y., Smith, M. L., Horner, A. J., Henson, R., Nathan, P. J., Bullmore, E. T., & Pulvermuller, F. (2012). Attention to language: novel MEG paradigm for registering involuntary language processing in the brain. *Neuropsychologia*, 50, 2605–2616. https://doi.org/10.1016/j.neuropsychologia.2012.07.012

Singh, N., & Mishra, R. K. (2013). Second language proficiency modulates conflict-monitoring in an oculomotor Stroop task: evidence from Hindi-English bilinguals. *Frontiers in Psychology*, 12(4), 322. https://doi.org/10.3389/fpsyg.2013.00322

Singh, N., & Mishra, R. K. (2015). Unintentional Activation of Translation Equivalents in Bilinguals Leads to Attention Capture in a Cross-Modal Visual Task. *PlonsOne*, 10(3). https://doi.org/10.1371/journal.pone.0120131

Singerland, E. (2003). *Effortless action: Wu-wei as conceptual metaphor and spiritual ideal in early China*. New York, NY: Oxford University Press.

Siquerra, M., & Gibbs, R. (2007). Children's acquisition of primary Metaphors: A cross-linguistic study. *Organon*, 43, 161–179.

Skoufaki, S. (2009). Investigating the source of idiom transparency intuitions. *Metaphor and Symbol*, 24, 20–41. https://doi.org/10.1080/10926480802568448

Slobin, D. I. (1985). Crosslinguistic evidence for the Language-Making Capacity. In D. I. Slobin (Ed.), *The crosslinguistic study of language acquisition*: Vol. 2. *Theoretical issues* (pp. 1157–1256). Hillsdale, NJ: Lawrence Erlbaum Associates.

Spaulding, S. (2013). Mirror Neurons and Social Cognition. *Mind and Language*, 28(2), 233–257. https://doi.org/10.1111/mila.12017

Sperry, R. W. (1950). Neural basis of the spontaneous optokinetic response produced by visual inversion. *J Comp Physiol Psychol*, 43(6) 482–489. https://doi.org/10.1037/h0055479

Spivey, M. (2007). *The continuity of mind*. New York, NY: Oxford University Press.

Steen, G. J., (1994). *Understanding metaphor in literature: An empirical approach*. London: Longman.

Steen, G. J. (2007). *Finding metaphor in grammar and usage*. Amsterdam: John Benjamins. https://doi.org/10.1075/celcr.10

Steen, G. J. (2008). The paradox of metaphor: Why we need a three-dimensional model for metaphor. *Metaphor & Symbol*, 23(4), 213–241. https://doi.org/10.1080/10926480802426753

Steen, G. J. (2011a). The contemporary theory of metaphor–now new and improved!. *Review of Cognitive Linguistics*, 9(1), 26–64. https://doi.org/10.1075/rcl.9.1.03ste

Steen, G. J. (2013). Deliberate metaphor affords conscious metaphorical cognition. *Journal of Cognitive Semiotics* 5 (1–2), 179–197.

Steen, G. J. (2015). Developing, testing and interpreting Deliberate Metaphor Theory. *Journal of Pragmatics*, 90, 67–72. https://doi.org/10.1016/j.pragma.2015.03.013

Steen, G. (2017), Deliberate Metaphor Theory: Basic assumptions, main tenets, urgent issues, Intercultural Pragmatics 2017; 14(1): 1–24.

Steen, G., Reijnierse, W. G., & Burgers, C. F. (2014). When do natural language Metaphors influence reasoning? A follow-up study to Thibodeau and Boroditsky (2013). *PLoS One*, 9(12): e113536. https://doi.org/10.1371/journal.pone.0113536

Steen, G.J., A.G., Dorst, B., Herrmann, A. Kaal, T. Krennmayr & T. Pasma (2010). *A Method for Linguistic Metaphor Identification: From MIP to MIPVU Converging Evidence in Language and Communication Research*, 14.

Stefanowitsch, A., & Gries, S. (2006). *Corpus-based approaches to metaphor and metonymy*. Berlin, Germany: Mouton. https://doi.org/10.1515/9783110199895

Storbeck, J., & Clore, G. L. (2008). Affective arousal as information: How affective arousal influences judgments, learning, and memory. *Social and Personality Psychology Compass*, 2, 1824–1843. https://doi.org/10.1111/j.1751-9004.2008.00138.x

Strack, F., Martin, L. L. & Stepper, S. (1988). Inhibiting and facilitating conditions of the human smile: a non obtrusive test of the facial feedback hypothesis. *J Pers Soc Psychol*, 54(5), 768–777. https://doi.org/10.1037/0022-3514.54.5.768

Strafella, A. P., & Paus, T. (2000). Modulation of cortical excitability during action observation: a transcranial magnetic stimulation study. *Neuroreport*, 11(10), 2289–2292. https://doi.org/10.1097/00001756-200007140-00044

Sur, S. & Sinha, V. K. (2009). Event-related potentials: An overview. *Industrial Psychiatry Journal*,18(1), 70–73. https://doi.org/10.4103/0972-6748.57865

Sweetser, E. (1990). *From etymology to pragmatics: Metaphorical and cultural aspects of semantic structure*. New York, NY: Cambridge University Press. https://doi.org/10.1017/CBO9780511620904

Symes, E., Tucker, M., Ellis, R., Vainio, L., Ottoboni, G. (2008) Grasp preparation improves change-detection for congruent objects. *J Exp Psychol Hum Percept Perform*, 34(4), 854–871. https://doi.org/10.1037/0096-1523.34.4.854

Talmy, L. (1988). Force dynamics in language and cognition. *Cognitive science*, 12(1), 49–100. https://doi.org/10.1207/s15516709cog1201_2

Talmy, L. (2000).*Toward a Cognitive Semantics*, Volume 2. Cambridge, Massachusetts; London: The MIT Press.

Taub, S. (2001). *Language from the body*. New York, NY: Cambridge University Press. https://doi.org/10.1017/CBO9780511509629

Tendahl, M., & Gibbs, R. (2008). Complementary perspectives on metaphor: Cognitive linguistics and relevance theory. *Journal of Pragmatics*, 40, 1823–1864. https://doi.org/10.1016/j.pragma.2008.02.001

Thelen, E., & Smith, L. B. (1994). *A dynamic systems approach to the development of cognition and action*. Cambridge, Massachusetts; London: The MIT Press.

Thelen, E., Schöner, G., Scheier, C., & Smith, L. (2001). The Dynamics of Embodiment: A Field Theory of Infant Perseverative Reaching. *Behavioral and Brain Sciences*. 24, 1–86. https://doi.org/10.1017/S0140525X01003910

Thibodeau, P., & Durgin, F. (2008). Productive figurative communication: Conventional Metaphors facilitate the comprehension of related novel Metaphors. *Journal of Memory and Language*, 58, 521–540. https://doi.org/10.1016/j.jml.2007.05.001

Tiemersma, D. (1989). *Body schema and body image : an interdisciplinary and philosophical study*. Amsterdam; Bristol, PA: Swets & Zeitlinger.

Tilley, C. (1999). *Metaphor and material culture*. Oxford, UK: Blackwell.

Tipper S. P., Paul, M., & Hayes, A. (2006). Vision-for-action: the effects of object property discrimination and action state on affordance compatibility effects. *Psychonomic Bull Rev*, 13, 493–498. https://doi.org/10.3758/BF03193875

Tracy, J.L. & D. Matsumoto. (2008). The spontaneous expression of pride and shame: Evidence for biologically innate nonverbal displays. *Proceedings of the National Academy of Sciences* 105(33). 11655–11660.

Tucker, M., & Ellis, R. (1998). On the relations between seen objects and components of potential actions. *J Exp Psychol Hum Percept Perform*, 24, 830–846. https://doi.org/10.1037/0096-1523.24.3.830

Turner, M. (1991). *Reading Minds: The Study of English in the Age of Cognitive Science*. Princeton: Princeton University Press.

Turner, M. (1996). *The literary mind*. Princeton., NJ: Princeton University Press.

Ulloa, E. R., Pineda, J. A. (2007). Recognition of point-light biological motion: mu rhythms and mirror-neuron activity. *Behav Brain Res*, 183:188–194. https://doi.org/10.1016/j.bbr.2007.06.007

Umiltà, M. A., Escola, L., Intskirveli, I., Grammont, F., Rochat, M., Caruana, F., Jezzini, A., Gallese, V., & Rizzolatti, G. (2008). When pliers become fingers in the monkey motor system. *Proc Natl Acad Sci USA*, 105(6), 2209–2213. https://doi.org/10.1073/pnas.0705985105

Urgesi, C., Candidi, M., Fabbro, F., Romani, M., & Aglioti, S. M. (2006). Motor facilitation during action observation: topographic mapping of the target muscle and influence of the onlooker's posture. *Eur J Neurosci*, 23(9), 2522–2530. https://doi.org/10.1111/j.1460-9568.2006.04772.x

Wagenmakers, E. J., Beek, T., Dijkhoff, L. and Gronau Q. F. (2016). Registered Replication Report: Strack, Martin, & Stepper (1988). *Perspectives on Psychological Science*, Vol. 11(6) 917–928. https://doi.org/10.1177/1745691616674458

Vainio, L., Ellis, R., Tucker, M. (2007). The role of visual attention in action priming. *Q J Exp Psychol A*, 60, 241–261. https://doi.org/10.1080/17470210600625149

Van Dam, W. O., Rueschemeyer, S. A., Lindemann, O., Bekkering, H. (2010) Context effects in embodied lexical-semantic processing. *Frontiers in Psychology*, 1, 1–6. https://doi.org/10.3389/fpsyg.2010.00150

VanDijk, T. A. & Kintsch, W. (1983). *Strategies of discourse comprehension*. New York: Academic Press.

Van Elk, M., Slors, M., & Bekkering, H. (2010). Embodied language understanding requires an enactivist paradigm of cognition. *Frontiers in Cognition*, 1–9. https://doi.org/10.3389/fpsyg.2010.00234

van Gelder, T. (2005), What might cognition be if not computation?, *Journal of Philosophy* 92 (7):345–381 (1995).
Vervaeke, J., & Kennedy, J. (1996). Metaphors in language and thought: Disproof and multiple meanings. *Metaphor and Symbolic Activity*, 11, 273–284. https://doi.org/10.1207/s15327868ms1104_3
Varela, F., Thompson, E., & Rosch, E. (1991). *The Embodied Mind: Cognitive Science and Human Experience*. Cambridge, Massachussets: The MIT Press.
Wagner, S., & Gunter, T. (2004). Determining inhibition: individual differences in the 'lexicon context' trade-off during lexical ambiguity resolution in working memory. *Exp.Psychol*. 51, 290–299. https://doi.org/10.1027/1618-3169.51.4.290
Wallace, S. (1982). Figure and ground: The interrelationships of linguistic categories. *Tense-aspect: Between semantics and pragmatics*, 1, 201–223. https://doi.org/10.1075/tsl.1.14wal
Waters, G., Caplan, D., & Yampolsky, S. (2003). On-line syntactic processing under concurrent memory load. *Psychonomic Bulletin & Review*, 10(1), 88–95. https://doi.org/10.3758/BF03196471
Wilcox, P. P. (1993). *Metaphorical Mapping in American Sign Language*. Unpublished PhD dissertation, University of New Mexico.
Wilcox, P. (2000). *Metaphor in American sign language*. Washington, DC: Gallaudet University Press.
Willems, R. (2017). *Cognitive Neuroscience of Natural Language Use*. Cambridge: Cambridge University Press.
Williams, L. E., & Bargh, J. A. (2008a). Experiencing physical warmth influences interpersonal warmth. *Science*, 322, 606–607. https://doi.org/10.1126/science.1162548
Williams, L. E., & Bargh, J. A. (2008b). Keeping one's distance: The influence of spatial distance cues on affect and evaluation. *Psychological Science*, 19, 302–308. https://doi.org/10.1111/j.1467-9280.2008.02084.x
Wilson, M. (2002). Six views of embodied cognition. *Psychonomic Bulletin & Review*, 9, 625–636.
Wilson, N., & Gibbs, R. (2007). Real and imagined body movement primes metaphor comprehension. *Cognitive Science*, 31, 721–731. https://doi.org/10.1080/15326900701399962
Winter, S. (2002). *A clearing in the forest: Law, life, and mind*. Chicago, IL: University of Chicago Press.
Winter, B. & T. Matlock. (2013). Making judgments based on similarity and proximity. *Metaphor and Symbol* 28(4). 219–232.
Wiseman, R. (2007). Ancient Roman Metaphors for communication. *Metaphor and Symbol*, 22, 41–78. https://doi.org/10.1080/10926480709336753
Williams, L. E. & J.A. Bargh. (2008). Experiencing physical warmth promotes interpersonal warmth. *Science* 322(5901). 606–607.
Wojciehowski, H., & Gallese, V. (2011). How Stories Make Us Feel: Toward an Embodied Narratology. *California Italian Studies*, 2,1.
Yu, N. (1999). *The contemporary theory of metaphor: A perspective from Chinese*. Amsterdam: John Benjamins.
Yu, N. (2003). Chinese Metaphors of thinking. *Cognitive Linguistics*, 14, 141–165. https://doi.org/10.1515/cogl.2003.006
Yu, N. (2008). *The Chinese heart in a cognitive perspective: Culture, body, and language*. Berlin, Germany: Mouton.
Zbikowski, L. (2002). *Conceptualizing music. Cognitive structure, theory, and analysis*. New York, NY: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195140231.001.0001

Zhong, C. B., & Liljenquist, K. (2006). Washing away your sins: Threatened morality and physical cleansing. *Science*, 313, 1451–1452. https://doi.org/10.1126/science.1130726
Zinken, J. (2007). Discourse Metaphors: The link between figurative language and habitual analogies. *Cognitive Linguistics*, 18(3), 445–466. https://doi.org/10.1515/COG.2007.024
Zinken, J., Hellsten, I., & Nerlich, B. (2008). Discourse Metaphors. In R. Dirven, R. Frank, T. Ziemke & J. Zlatev (Eds.), *Body, Language, and Mind* Vol. 2: *Sociocultural Situatedness* (pp. 363–385). Berlin: Mouton.
Zwaan, R. A. (2014). Embodiment and language comprehension: reframing the discussion. *Trends Cogn Sci*, 18(5), 229–234. https://doi.org/10.1016/j.tics.2014.02.008
Zwaan, R. A. (2015). Situation models, mental simulations, and abstract concepts in discourse comprehension. *Psychonomic Bulletin & Review*, June 2015.

Subject index

The last decades of the twentieth century have witnessed a fundamental scientific discovery: the identification of mirror neurons and, consequently, the development of the Embodied Simulation theory. Neuroscientific data on the mechanism of Embodied Simulation and its role in conceptual and linguistic processing, figurative language included, have stimulated a great deal of research on the embodied nature of conceptual metaphors. However, the very definition of the notions of body and embodiment are today still controversial in the Embodied Cognition debate. This book addresses the issue of the specific contribution of the body to conceptual and linguistic processing and provides a new definition for the mechanism of Embodied Simulation. In this light, and in consideration of a revision of the contemporary theory of metaphor recently introduced by Gerard Steen, who distinguished between deliberate and non-deliberate metaphor processing, the book also proposes a new model of metaphor processing that brings together the mechanism of Embodied Simulation, on the one hand, and the notion of deliberateness on the other. Modulation of attention during linguistic processing is a key component in explaining how they interact.

Potential readers of the book include linguists, psychologists, philosophers and any other cognitive scientists and communication scientists piqued by the topic of metaphor and embodiment.

ISBN 978 90 272 0211 6

9 789027 202116

John Benjamins Publishing Company