

UTRECHT UNIVERSITY

Department of Natural Sciences

HPS Master thesis

**MIRROR, MIRROR IN THE BRAIN, WHAT'S THE  
INTERDISCIPLINARY INTERACTION FOR MY DOMAIN:  
A DESCRIPTION OF THE EMERGENCE OF MIRROR NEURON EMPATHY AS  
A CASE OF NEUROSCIENCE IMPERIALISM FACILITATED BY  
DISCIPLINARY BRIDGING**

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# Introduction

In 1992 an Italian research team at the Institute of Physiology in Parma, led by neuroscientist Giacomo Rizzolatti, published a seemingly innocuous research note in the *Experimental Brain Research* journal.<sup>1</sup> This brief note would later be known as the very first description of ‘mirror neurons’, a type of neuron whose discovery would subsequently prove to have a massive impact within a broad range of academic disciplines, but most notably within social neuroscience. The article in question, *Understanding Motor Events: A Neurophysiological Study*, cites Giuseppe Di Pellegrino, Giacomo Rizzolatti, Luciano Fadiga, Leonardo Fogassi, and Vittorio Gallese as its authors.<sup>2</sup> Later, this research team would commonly be referred to as ‘the Parma team’, a shorthand I will continue to use myself.<sup>3</sup> The Parma team had been conducting research on the premotor cortex of macaque monkeys since 1988. At the time of the issuing of their first mirror neuron publication, they were studying grasping actions and their correlation to the firing of single neurons in the brain.<sup>4</sup> In other words, they were trying to identify specific neurons involved in grasping actions to map their properties. To achieve this feat, they opted for a technique called ‘single unit recording’, in which electrodes are directly transplanted in the macaque’s brains and meticulously attached to single neurons. This enabled the Parma team to determine precisely when and which neurons were activated during these grasping tasks.<sup>5</sup>

It is during one of these experiments that, one day, an accidental, but intriguing observation was made. In between recordings, the scientists were required to switch around objects in front of the monkeys, and during one of these switches, one of these scientists noticed that the macaque neurons were firing when they saw the experimenters grabbing these objects. To their astonishment, they later found that the pattern recorded when the monkeys were watching the human experimenters grabbing the objects, was the very same pattern that had been observed when the monkeys had been grabbing these objects themselves. In other words, during their

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<sup>1</sup> G. Pellegrino. et al, “Understanding Motor Events: A Neurophysiological Study,” *Experimental Brain Research* 91, no. 1 (1992): 176-80. <https://doi.org/10.1007/BF00230027>.

<sup>2</sup> G. Pellegrino. Et al, “Understanding Motor Events: A Neurophysiological Study,” 176.

<sup>3</sup> Publications with three or more of the original members will be referred to as written by the ‘Parma team’ throughout this thesis. This shorthand is also used by for example Gregory Hickock, see next footnote.

<sup>4</sup> Gregory Hickok, *The Myth of Mirror Neurons: The Real Neuroscience of Communication and Cognition*. New York: W.W Norton & Company, 2014. (epub version) 25.

note: the page numbers might not correspond to the paper version of the book, all the citations in this chapter can be found in the introduction and first chapter of the book.

<sup>5</sup> Gregory Hickok, *The Myth of Mirror Neurons*, 25.

observations of grasping actions, the monkey brains were lit up as if they were performing the action themselves. Even more strikingly, the neuronal activation in the monkey brains during action observation corresponded to the specific type of action they were observing. For example, if a monkey observed a human grasping something very small, the pattern that corresponds to the monkey itself grabbing a very small object would light up in the monkey's brain.<sup>6</sup> This finding was soon published in the Parma team's 1992 initial research note and it is these neurons that would later become known as 'mirror neurons'. In an autobiographical paper, head-researcher Rizzolatti mentions that this research note was first rejected by *Nature* before being accepted by *Experimental Brain Research*, due to 'lack of general interest'.<sup>7</sup> The coming decade would decidedly prove *Nature* wrong.

During the course of the 1990s and the early 2000s, mirror neurons would gain an increasing amount of attention within both popular scientific and academic circles. A good illustration of the extent that this excitement reached in the early 2000s is the following quote by prominent neuroscientist V.S Ramachandran:

"I predict that mirror neurons will do for psychology what DNA did for biology: they will provide a unifying framework and help explain a host of mental abilities that have hitherto remained mysterious and inaccessible to experiments."<sup>8</sup>

Clearly, *Nature* had miscalculated the potential consequences of the discovery. Furthermore, popular publications such as *The New York Times* and academic papers alike were putting out articles linking these neurons to all kinds of phenomena, from mental disorders like autism and schizophrenia to business leadership, spectator sport appreciation, love, and particularly relevant for my purposes, empathy.<sup>9</sup>

This brings me to the issue at hand in this thesis: the description of the development of the theory of mirror neuron empathy. As I will show, Vittorio Gallese, one of the members of the Parma team, was the first to posit mirror neurons as the basis for the social phenomenon of empathy. This connection was quickly picked up by other researchers and thereafter became an

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<sup>6</sup> Giacomo Rizzolatti, "Giacomo Rizzolatti," in *The History of Neuroscience in Autobiography Volume 9*, eds. Thomas D. Albright and Larry R. Squire, (Washington DC: Society for Neuroscience, 2016), 354.

<sup>7</sup> Giacomo Rizzolatti, "Giacomo Rizzolatti," 355.

<sup>8</sup> Ramachandran, Vilayanur, "Mirror Neurons and Imitation Learning as the Driving Force behind the Great Leap Forward in Human Evolution," Edge.org, May 2009.  
<https://www.edge.org/conversation/vilayanur-ramachandran-mirror-neurons-and-imitation-learning-as-the-driving-force>.

<sup>9</sup> Gregory Hickok, *The Myth of Mirror Neurons*, 63.

influential component of the emerging field of social neuroscience. The founders of this new discipline claimed that their discipline was characterized by the integration of both neuroscientific and social psychological theories. Social neuroscience was to be the result of an integrative form of interdisciplinarity between social psychology and neuroscience that corresponds to a classical theoretical definition of this notion within the philosophy of science. This connection between mirror neuron empathy and interdisciplinarity within social neuroscience takes me to the aim of my thesis, which is to describe the emergence of mirror neuron empathy in terms of interdisciplinary interactions, using the framework that best suits the historical facts of my case study. To achieve this I will retrace the early history of mirror neuron empathy starting with the 1992 discovery of mirror neurons, and using primary literature up to 2010, the year of the establishment of the Society for Social Neuroscience. As will become apparent, what happened in practice during the development of mirror neuron empathy, does not correspond to the expectations set out by its parent discipline. Instead of having emerged through classic interdisciplinary interactions between social psychology and neuroscience, Gallese's mirror neuron empathy was the product of interdisciplinarity between neuroscience and philosophy. Furthermore, I will also establish that the interactions at hand cannot fully be described using the traditional, theoretical framework for interdisciplinarity. Instead, I will introduce a contemporary, more practical framework for interdisciplinarity, developed by philosopher Uskali Mäki. His flexible definition of interdisciplinarity paired with a new conceptual toolbox for its description, will enable me to more accurately represent my history of mirror neuron empathy. Instead of describing the emergence of mirror neuron empathy as a classical interdisciplinary interaction between social psychology and neuroscience, I will claim that the emergence of mirror neuron empathy is best described using a practical framework for interdisciplinarity which allows for its description as a case of neuroscience imperialism facilitated by disciplinary bridging through philosophy. In doing this I want to contribute to a contemporary debate within the philosophy of interdisciplinarity, namely the call for the development of new, more practically oriented frameworks for interdisciplinarity. Through my research, I hope to show the value of such frameworks in the description of interdisciplinary science in action.

Of course, my argumentation needs further elaboration and contextualization, which I aim to provide in the remainder of this introduction. I will begin by establishing the popularity of mirror neuron empathy research, and move on to some criticism of mirror neuron empathy. This will allow me to argue for the value of a socially oriented history of mirror neuron empathy,

as the association between mirror neurons and empathy is not an inevitable scientific necessity. This will then lead me to a quick exploration of the history of empathy before the discovery of mirror neurons in which I will specifically focus on empathy within social psychology and philosophy. These two disciplines will turn out to be especially relevant to my argument. In the last part of this introduction, I will once again reiterate the aims of my thesis and give a more thorough chronological overview of my argumentation. I will end by providing the reader with explicit contributory aims and some methodological notes.

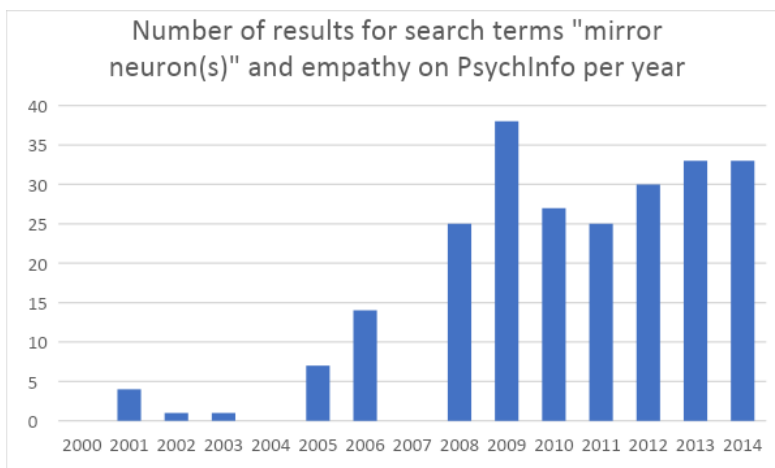
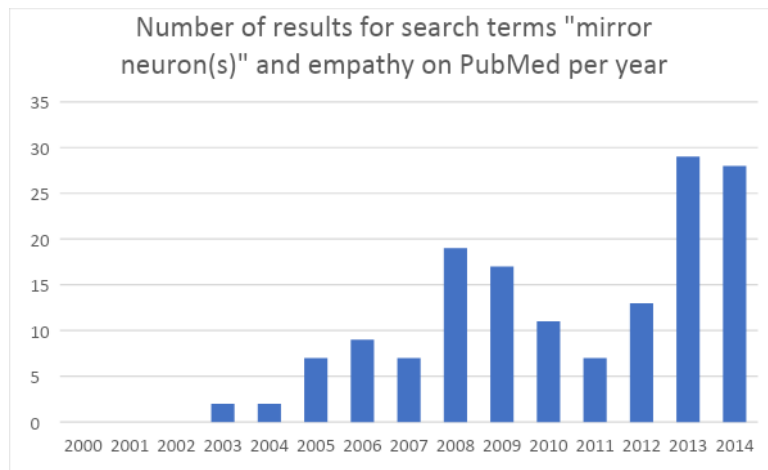
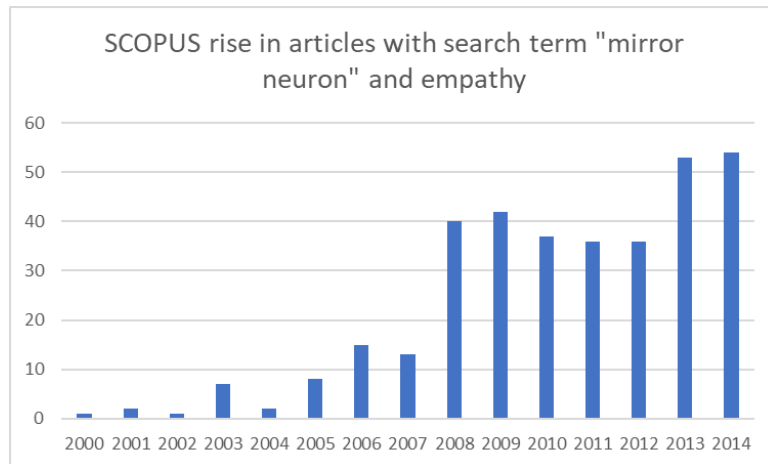
### **Mirror neurons as a trend in empathy research and subsequent criticism**

I want to begin my exploration of mirror neuron empathy by briefly establishing its existence and reception. The most efficient way of illustrating the rise of mirror neuron empathy within academic research is through the use of illustrative graphs, showing a growing connection between mirror neurons and empathy. To achieve this I have graphed the number of hits on academic databases for the search terms ‘mirror neuron(s)’ and ‘empathy’ over the first years of the 21<sup>st</sup> century. The graphs below respectively show the progression over the years on the PubMed, the SCOPUS, and the PsychInfo database (figures 1,2,3).<sup>10</sup> The year range for these graphs has been restricted to 2000-2014, as the connection between mirror neurons and empathy wasn’t made before 2001 (see Chapter 2). It should be noted, however, that these graphs are not normalized, as the databases in question do not offer any information about the total amount of publications from any given year. This means that these graphs should be seen in conjunction with literature which similarly suggests that research linking mirror neurons and empathy was a lively research field. This link is described both in Suzan Lanzoni’s *Empathy: A History* and in Gregory Hickok’s *The Myth of Mirror Neurons* and acknowledged in the wider literature about empathy.<sup>11</sup>

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<sup>10</sup> PubMed, National Library of Medicine: National Center for Biotechnology Information, <https://pubmed.ncbi.nlm.nih.gov/>; Scopus, Elsevier B.V., <https://www.scopus.com/home.uri>; APA PsychInfo, American Psychological Association, <https://www.apa.org/pubs/databases/psycinfo>

<sup>11</sup> Gregory Hickok, *The Myth of Mirror Neurons*, 6-12 (preface); Susan Marie Lanzoni, *Empathy: A History*, (New Haven: Yale University Press, 2018), 300-331; Claus Lamm, and Jasminka Majdandžić, “The Role of Shared Neural Activations, Mirror Neurons, and Morality in Empathy – A Critical Comment,” *Neuroscience Research* 90 (2015): 15-24. <https://doi.org/10.1016/j.neures.2014.10.008>.



**Figures 1,2,3:** Number of articles with the search term empathy and mirror neuron in the PubMed, SCOPUS, and PsychInfo databases



Although these graphs and the cited literature prove that mirror neuron empathy was indeed a lively field of research in the early 2000s, it should not be seen as proof of scientific consensus around this issue. In fact, it was followed by its fair share of criticism. Not all researchers were convinced of such a straightforward link between mirror neurons and empathy. Claus Lamm and Jasminka Majdandžić, for example, published a critical evaluation of claims of mirror neuron empathy. In their article, they criticize social neuroscientific mirror neuron empathy research for having jumped to this link too quickly:

“The prevalence of such assumptions in the public reception and media discourse has certainly been fueled by some rather uncritical popular science books, but also by *early publications of scholars in the field of social neuroscience who linked the two phenomena quite liberally, but without much hard evidence*. Yet, such a view is problematic in several ways: on the one hand, it lacks empirical support or even contradicts it; on the other, it has broad but misleading implications for our general understanding of empathy.”<sup>12</sup>

Lamm and Majdandžić were not alone in their criticism. Another prominent skeptic about mirror neuron theories of both language and empathy is Gregory Hickok, who published a paper outlining his criticism in 2009, which eventually turned into a book called *The Myth of Mirror Neurons*. As the title indicates, Hickok voices some skepticism about the enthusiasm surrounding mirror neuron theory. In general, he believes that many conclusions drawn by early mirror neuron researchers were premature and blind to contradicting evidence.<sup>13</sup>

All of this is to say that, although the connection between mirror neurons and empathy was established in the early 2000s, the link between these phenomena is not a necessary conclusion directed by inescapable empirical facts. This criticism confirms that a description of the emergence of mirror neuron empathy with reference to other factors than the pure scientific content of these theories is called for. More specifically, as I have already mentioned, I believe that the best approach to this description is through the lens of the philosophy of interdisciplinarity. As I established in my description of their discovery, mirror neurons are a concept that emerged within neuroscientific research. Empathy, on the other hand, is a concept that has traditionally been a subject of study for more socially oriented disciplines. Therefore I

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<sup>12</sup> Claus Lamm, and Jasminka Majdandžić, “The Role of Shared Neural Activations, Mirror Neurons, and Morality in Empathy – A Critical Comment,” *Neuroscience Research* 90 (2015): 19. <https://doi.org/10.1016/j.neures.2014.10.008>.

<sup>13</sup> Gregory Hickok, *The Myth of Mirror Neurons*, 6-12 (preface); Gregory Hickok, “Eight Problems for the Mirror Neuron Theory of Action Understanding in Monkeys and Humans,” *Journal of Cognitive Neuroscience* 21, no. 7 (July 1, 2009): 1229–43. <https://doi.org/10.1162/jocn.2009.21189>.

believe that it is relevant to look at the interdisciplinary interactions between neuroscientific theory and social scientific theories of empathy. To further contextualize empathy as a social phenomenon I will now move on to a short history of relevant social scientific empathy research.

### **Empathy before mirror neuron empathy**

I now turn to a very brief and restricted history of ‘empathy’ to lay out some relevant clarifications. ‘Empathy’ has a complicated history, and is associated with multiple academic disciplines. I will begin by providing a brief overview of the origins of the term and show how the common origin in German aesthetics later branched out and was included within several different disciplines. I will not dwell on all of these disciplines but focus on philosophy and social psychology, which are the most relevant to my thesis.

The term ‘empathy’ is a rather recent addition to the English language which has its roots in late 19th century German aesthetics.<sup>14</sup> In 1909 the English experimental psychologist Edward Titchener translated the popular German term ‘Einfühlung’ into the English neologism ‘empathy’.<sup>15</sup> He constructed the term ‘empathy’, by combining the Greek words ‘en’, which means ‘in’, and ‘pathos’, which means ‘feeling’ or ‘passion’. His choice was an attempt at fully representing the meaning of ‘Einfühlung’, which in German literally translates to ‘feeling into’.<sup>16</sup> Titchener had been introduced to this concept through the work of Theodor Lipps, who is generally considered to be the father of the first theory of empathy.<sup>17</sup> In its original aesthetic meaning, ‘empathy’ meant the projection of the internal motions a piece of art evoked within an observer back onto the art object. However, this initial interpretation of the concept by Lipps quickly evolved, and in 1905, in his address at the Congress of Psychology, Lipps posited Einfühlung as a way to understand other people’s emotions.<sup>18</sup> To Lipps, Einfühlung had become an explanation of how we immediately and intuitively understand other people’s emotions as we perceive them. Einfühlung according to Lipps was characterized as an instinctive drive that does not require inferential reasoning and which had its roots in a

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<sup>14</sup> Susan Marie Lanzoni, *Empathy: A History*, 23.

<sup>15</sup> Gustav Jahoda, “Theodor Lipps and the Shift from Sympathy To Empathy,” *Journal of the History of the Behavioral Sciences* 41, no. 2 (2005): 161.

<sup>16</sup> Lauren Wispé, “History of the Concept of Empathy,” in *Empathy and its Development*, Eds. Nancy Eisenberg and Janet Strayer, (Cambridge: Cambridge University Press, 1990), 21.

<sup>17</sup> Christiane Montag, Jürgen Gallinat and Andreas Heinz, “Theodor Lipps and the Concept of Empathy: 1851-1914,” *American Journal of Psychiatry* 165, no. 10 (October 2008): 1261.

<https://doi.org/10.1176/appi.ajp.2008.07081283>.

<sup>18</sup> Susan Marie Lanzoni, *Empathy: A History*, 37.

mechanism of ‘inner imitation’.<sup>19</sup> When we see a person making angry gestures at us, we intuitively understand that that person is angry, because witnessing those gestures makes us mentally imitate those movements, which in turn makes us feel the emotions associated with those movements.<sup>20</sup> This brings us to the moment of Titchener’s translation and adoption of the term, and therefore to the birth of ‘empathy’ proper.

During the next decades of the 20<sup>th</sup> century the term ‘Einfühlung’, and its newly minted English brother ‘empathy’ were starting to take on many different meanings, spanning the categories of aesthetics, philosophy, psychiatry, and psychology. A full account of these different branches falls beyond the scope of my thesis, but as will become apparent later, it is interesting to very briefly look at its reception within philosophical phenomenology and social psychology. Firstly, Lipps’ Einfühlung, or empathy was soon adopted by philosophical phenomenology in the works of Husserl and Stein. To the phenomenologists, empathy was a unique and immediate perception of other embodied minds that allows us to participate in another’s lived experience.<sup>21</sup> This empathetic perception of others was then posited as the basis for human social interaction. The logic behind this goes something like this: all humans have similar bodies. These bodies enable us to perform certain actions. This means that all humans have a roughly similar internal library of possible actions that can be performed. It is because we all have this shared library of actions that we can understand the actions performed by others. I will come back to this phenomenological understanding of empathy in Chapter 2, as it was instrumental in the development of mirror neuron empathy.

Another field where empathy research became a topic of interest is social psychology, which a 2013 handbook for the discipline describes as “ the study of the interface between (...) the nature and causes of human social behavior.”<sup>22</sup> Surprisingly enough the topic of empathy was not mentioned in any handbook of social psychology before the 1960s. In the decades after WWII ‘empathy’ had gained a normative connotation, the idea of a more empathetic world was linked to the ideal of social harmony. Therefore social psychological research started linking empathy to positive social phenomena such as helping and altruism at around this time.<sup>23</sup> An

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<sup>19</sup> Gustav Jahoda, “Theodor Lipps and the Shift from Sympathy to Empathy,” 156.

<sup>20</sup> Gustav Jahoda, “Theodor Lipps and the shift from sympathy to empathy,” 156-157.

<sup>21</sup> James Jardine and Thomas Szanto, “Empathy in the phenomenological tradition,” in *The Routledge Handbook of Philosophy of Empathy* Ed. Heidi Maibom, 1st ed. (New York : Routledge, 2017), 87-88.

<sup>22</sup> John D DeLamater and Amanda Ward, *Handbook of Social Psychology*. 2nd edition. Handbooks of Sociology and Social Research. (Dordrecht New York: Springer, 2013), vi.

<sup>23</sup> Lauren Wispé, “History of the concept of empathy,” 33.

important figure in the research of empathy and its connection to morality is the social psychologist Martin Hoffman, who in 1978 proposed the following influential definition: “Empathy may thus be defined simply in terms of the arousal of affect in the observer that is not a reaction to his own situation but a vicarious response to another person's situation”.<sup>24</sup> Hoffman was also one of the first behavioral scientists to re-introduce mimicry as a basis for a primitive form of empathy within his theory, influenced by Lipp’s definition of the term. This research was later followed up by other social psychologists such as Elaine Hatfield, who in the 1990s likewise proposed motor mimicry as an underlying mechanism for emotional contagion, namely the idea that emotions can be ‘contagious’ through observation. If I see someone crying, for example, I might feel sad myself because my observation of their sadness makes my body mimic their emotional state, resulting in my feeling a similar emotion.<sup>25</sup> With this history and examples in mind, it is safe to say that empathy had been and was currently a topic of research within social psychology at the time of the discovery of mirror neurons.

### **The argument**

Through this short overview of the history of empathy, I have now established that empathy was a concept that was traditionally part of at least two disciplines within the social domain, social psychology, and philosophy. My focus on these disciplines is no coincidence. I believe that it is through interdisciplinary interactions with these two disciplines on the one hand, and neuroscience on the other, that mirror neuron empathy could emerge as a part of the then-upcoming discipline of social neuroscience. My thesis aims to describe the emergence of mirror neuron empathy using the framework that best suits the historical facts. In doing so I want to contribute to an ongoing debate within the philosophy of interdisciplinarity, and argue for the value of more practical approaches to the concept of interdisciplinarity.

A logical starting point for studying this interdisciplinary interaction is through the use of a traditional theoretical framework of interdisciplinarity which is widely adhered to within philosophy of science. I will term this framework for interdisciplinarity the ‘classic integrative picture of interdisciplinarity’ (CIPI). In my first chapter, I will begin by reconstructing the framework of the CIPI, and present the reader with some of its main characteristics. This framework is doubly interesting because not only is it the most common understanding of ‘interdisciplinarity’ among philosophers of science, but it is likewise part of the self-

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<sup>24</sup> Martin L. Hoffman, “Toward a Theory of Empathic Arousal and Development,” in *The Development of Affect*, eds. Michael Lewis and Leonard A. Rosenblum (Boston MA: Springer US, 1978), 229.

<sup>25</sup> Elaine Hatfield et al, “Emotional Contagion,” (Cambridge: Cambridge University Press, 1994), 5.

understanding of the parent discipline of mirror neuron empathy, namely social neuroscience. As we will see, social neuroscientists described the emergence of their discipline as CIPI-type interdisciplinarity between social psychology and neuroscience. As mirror neuron empathy is commonly seen as one of the foundational research programs of social neuroscience, it is a good candidate for a case study on the interdisciplinary interactions that contributed to social neuroscience more generally. Furthermore, as social neuroscientists themselves theoretically adhere to the philosophical CIPI ideal in their disciplinary self-conceptualization, looking at a case study of social neuroscience could provide a good practical example for the application of the CIPI framework to scientific practice.

Unfortunately, as will become apparent in Chapter 2, the historical facts do not line up with social neuroscience's self-concept as a CIPI-type interaction between social psychology and neuroscience. I will show that the first theory of mirror neuron empathy formulated by Gallese, one of the members of the Parma team, was constructed through interaction with philosophy instead. Interaction between neuroscience and social psychology is absent in Gallese's work, and scarce at best within the work of his successors. Aside from challenging social neuroscience's self-concept, I will likewise show that the CIPI framework is an inadequate toolkit to describe this history at all.

This brings me to my final chapter, in which I will outline a more recent and practical definition of interdisciplinarity. In recent years a number of philosophers of science have protested the rigidity of the theoretical CIPI-ideal, due to its poor applicability to the description of interdisciplinarity within scientific practice. In the presentation of this alternative to CIPI, I will follow the Finnish philosopher of science Uskali Mäki, who has formulated such an alternative practical framework for interdisciplinarity. This framework includes a new subtype of interdisciplinary interaction, namely scientific imperialism. I believe that Mäki's framework for this subtype of practical interdisciplinarity will provide me with a useful toolkit for the description of the complicated development of mirror neuron empathy. In the final part of this chapter, I will describe this history using the vocabulary Mäki developed for his concept of scientific imperialism. Although Mäki's framework contains some normative elements, I will restrict myself to modifying his concepts to only retain their descriptive aspects, and abstain from any normative evaluation of my case study. In the spirit of the call for the introduction of new, empirically based conceptual tools for describing interdisciplinary interactions, I will furthermore introduce a new concept, namely 'disciplinary bridging', as a mechanism for scientific imperialism.

This finally leads me to my thesis statement, which reads as follows: The emergence of mirror neuron empathy is best described using a practical framework for interdisciplinarity which allows for its description as a case of neuroscience imperialism facilitated by disciplinary bridging through philosophy.

### Contributory aims

The first contributory aim of my thesis is to advance philosophical debates surrounding interdisciplinarity and one of its subtypes, scientific imperialism, through the analysis of my case study. One of the ongoing debates within the contemporary philosophy of interdisciplinarity is the formulation of alternatives to CIPI that better reflect scientific practice.<sup>26</sup> The recent literature on the philosophy of interdisciplinarity, furthermore generally agrees on the idea that much remains to be done in the development of these alternatives.<sup>27</sup> I hope to show that, in the case of mirror neuron empathy, the ideal of interdisciplinarity set out by its parent discipline, which corresponds to the CIPI, is not a good fit for analyzing the reality of its development. In doing this I do not only want to show that social neuroscience might be misrepresenting at least part of its discipline but also use this specific case study as an example that illustrates the necessity of alternatives to CIPI. I hope to show that practically oriented frameworks, such as the one worked out by Mäki, are useful in the description of complicated case studies of interdisciplinary interaction, such as mirror neuron empathy. Furthermore, I wish to actively contribute to this approach to interdisciplinarity by introducing my concept of ‘disciplinary bridging’ as a concept based on the observation of interdisciplinarity in action.

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<sup>26</sup> Uskali Mäki and Miles MacLeod, “Interdisciplinarity in Action: Philosophy of Science Perspectives,” *European Journal for Philosophy of Science* 6, no. 3 (October 2016): 323–26. <https://doi.org/10.1007/s13194-016-0161-1>; Henrik Thorén, and Johannes Persson, “The Philosophy of Interdisciplinarity: Sustainability Science and Problem-Feeding,” *Journal for General Philosophy of Science* 44, no. 2 (December 2013): 337–55. <https://doi.org/10.1007/s10838-013-9233-5>; Grüne-Yanoff, Till. ‘Interdisciplinary Success without Integration’. *European Journal for Philosophy of Science* 6, no. 3 (October 2016): 343–60. <https://doi.org/10.1007/s13194-016-0139-z>; note: the entire 3rd issue of the 6th volume of this journal (*European Journal for Philosophy of Science*) is dedicated to the Philosophy of Interdisciplinarity and these debates; Miles MacLeod, Martina Merz, Uskali Mäki, and Michiru Nagatsu, “Investigating Interdisciplinary Practice: Methodological Challenges (Introduction),” *Perspectives on Science* 27, no. 4 (August 2019): 545–52. [https://doi.org/10.1162/posc\\_e\\_00315](https://doi.org/10.1162/posc_e_00315).

<sup>27</sup> Uskali Mäki, Adrian Walsh, and Manuela Fernández Pinto, eds. “Introduction” In *Scientific Imperialism: Exploring the Boundaries of Interdisciplinarity: Routledge Studies in Science, Technology and Society* (New York: Routledge, Taylor & Francis Group, 2018), 1-10; Mäki, Uskali. “Philosophy of Interdisciplinarity. What? Why? How?,” *European Journal for Philosophy of Science* 6, no. 3 (October 2016): 327–42. <https://doi.org/10.1007/s13194-016-0162-0>; Mäki, Uskali. “Scientific Imperialism: Difficulties in Definition, Identification, and Assessment,” *International Studies in the Philosophy of Science* 27, no. 3 (September 2013): 325–39. <https://doi.org/10.1080/02698595.2013.825496>.

Secondly, although some authors hint at the existence of neuroscience imperialism specifically, this particular form of imperialism is underdeveloped in the current literature.<sup>28</sup> The case of mirror neurons specifically could provide one of the first thorough analyses of a case of neuroscience imperialism, through which insights into its reality in practice could be gained.

A last, auxiliary aim of this research is to contribute to the history of one of social neuroscience's first prominent research programs. By retracing how mirror neuron empathy was developed, some insight might be gained into how the discipline of social neuroscience emerged around the beginning of the 21<sup>st</sup> century. In their contribution to *The Oxford Handbook of Social Neuroscience*, Matusall et al. designate mirror neurons as one of three major developments that led to the extension of neuroscience to the social domain.<sup>29</sup> Similarly, Lieberman also points towards the discovery of mirror neurons as one of the milestones in the emergence of social neuroscience and identifies research into empathy and mirror neurons as characteristic of (European) social neuroscience.<sup>30</sup> However, none of these authors, nor any others provide us with a detailed history of this development, providing me an opportunity to fill in the gap. I claim that by describing how exactly the neuroscientific notion of empathy came to be associated with the more social psychological/philosophical concept of empathy, new insight into the emergence of this discipline could be gained. This could not only mean a deeper understanding of the disciplinary history but also indicate the necessity for a re-evaluation of social neuroscience's disciplinary self-concept.

### **Some methodological notes**

Firstly I will be focusing on the development of the interpretation of mirror neuron theory by the research team that discovered them. This will enable me to retrace this history from its very beginning and will permit me to recount its evolution in detail. One of the original members of the research team, namely Vittorio Gallese, was the first person to formulate a mirror neuron theory of empathy. Without this restriction, the amount of literature would simply be

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<sup>28</sup> Uskali Mäki, "Scientific Imperialism," 325; Roberto Fumagalli, "Against Neuroscience Imperialism," In *Scientific Imperialism: Exploring the Boundaries of Interdisciplinarity* Uskali Mäki, Adrian Walsh & Manuela Fernández Pinto eds. (New York: Routledge, Taylor & Francis Group, 2018), 205-223.

<sup>29</sup> Svenja Matusall, Ina Maria Kaufmann, and Markus Christen, "The Emergence of Social Neuroscience as an Academic Discipline," in *The Oxford Handbook of Social Neuroscience, Oxford Library of Psychology*, Jean Decety, and John T. Cacioppo eds., (2011; online edn, Oxford Academic, 18 Sept. 2012), 17-18. <https://doi-org.proxy.library.uu.nl/10.1093/oxfordhb/9780195342161.013.0002>

<sup>30</sup> Lieberman, Matthew D., "A Geographical History of Social Cognitive Neuroscience," *NeuroImage* 61, no. 2 (June 2012): 433–35. <https://doi.org/10.1016/j.neuroimage.2011.12.089>.

overwhelming and the development would be impossible to recreate. I don't claim that Gallese's is the only theory that emerged around this time, nor that it was the only influential one. What I do however believe, is that this is the first instance of mirror neuron empathy and that it therefore offers an interesting perspective on how neuroscience came to formulate a theory of empathy in the first place.

Secondly, I will restrict myself to the primary literature from 1992, when mirror neurons were first discovered, to 2010, while focusing primarily on the early research (1992- 2006) and researchers closely associated with the original Parma research group. This choice is, again, partly motivated by pragmatic considerations, but also in part to accommodate my primary research aim, namely understanding the interdisciplinary interactions at the origin of a social neuroscientific mirror neuron theory of empathy. My interest lies more in how this theory emerged than in elucidating exactly what happened after mirror neuron theories of empathy became entrenched in social neuroscience. Furthermore, 2010 is the year in which the Society for Social Neuroscience was established, which seems a fitting end point to the early years of the discipline.<sup>31</sup> It is very possible that the type of interdisciplinary interaction between social neuroscience and social psychology shifted over time, as social psychologists got time to integrate the popular new mirror neuron theories within their own discipline, but once again, while relevant, these developments fall beyond the scope of my research.

Lastly, I want to note that I will be restricting my research of interdisciplinary interaction to the disciplines of neuroscience, philosophy, and social psychology and their collective involvement in the emerging discipline of social neuroscience. Within the literature detailing the history of social neuroscience, the field is sometimes also referred to as an interaction between social science in general and neuroscience (see Chapter 1). However, many of these publications make a point of singling out social psychology as the most relevant social science which is allegedly a constitutive part of social neuroscience. Given this fact, I will explicitly be focusing on the discipline of social psychology. This furthermore means that I will not be concerning myself with the interaction between (social) neuroscience, and other less socially oriented branches of psychology, such as experimental psychology or neuropsychology. These disciplines might have displayed an entirely different type of interaction with neuroscientific mirror neuron research, but this interaction is not relevant in the context of my thesis.

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<sup>31</sup> Society for Social neuroscience, "History" <https://www.s4sn.org/mission>.



# Chapter 1 The CIPI, a theoretical framework for interdisciplinarity and social neuroscience

In this first chapter I will introduce the reader to what I term ‘the classical integrative picture of interdisciplinarity’ (CIPI). This view of interdisciplinarity is a reconstruction of what is most oftentimes meant by this term within the theoretical philosophical literature. Although no consensus exists about a precise definition of interdisciplinarity, the CIPI I will be presenting is a reconstruction of a commonplace theoretical understanding of what an interdisciplinary interaction should look like. In this chapter, I will begin by constructing the theoretical CIPI ideal and present the reader with three characteristics that define it, namely a drive towards integration/unification, a tendency towards explanatory reductionism, and extensive interaction between the disciplines concerned. After I have established this philosophical ideal, I will move on to the description of a field that is traditionally seen as a prime example of this type of interdisciplinarity, namely social neuroscience. In doing this I will show that the scientists within this field of study similarly conceptualize their field in terms of the very same CIPI ideal. Lastly, I will show that mirror neuron empathy is an important component of social neuroscience, as the discovery of mirror neurons is oftentimes cited as one of the reasons for its emergence. This will ultimately lead me to summarize what a mirror neuron theory of empathy should look like based on the theoretical ideal set out by philosophers, and the scientists involved. In doing this I will be able to contrast this picture with what happened in scientific practice in Chapter 2.

## **Defining disciplinarity**

What exactly do I mean to say when I use the word ‘discipline’? Answering this question is needed to illuminate what is meant by ‘interdisciplinarity’. In defining disciplinarity I follow Finnish philosopher of science Uskali Mäki, who will prove to be an important figure in the last chapter of this thesis. Mäki’s definition of disciplinarity reads as follows:

“Disciplines are institutional structures that involve conventions and convictions, standards and strategies, ideals and identities, principles and practices, styles and statuses, rules and resources, ordinances and organizations.”<sup>32</sup>

Disciplines are institutional social entities. The institution in question here is the modern research university, an institutional structure that emerged at the beginning of the 19<sup>th</sup> Century. Within these institutions, certain groups of researchers began specializing in distinct fields of knowledge, each with their own languages, methods, instruments, values, and cultures.<sup>33</sup> This internal specialization of academic research into separate disciplines furthermore came with several external disciplinary markers: specialized journals, conferences, societies, handbooks, etc.<sup>34</sup> Disciplines, therefore, have an epistemic aspect to them, namely the specific knowledge and methods of study they focus on, and an institutional or social aspect, namely the institutional markers, their specific culture, and language. This description of ‘disciplines’ or ‘disciplinarity’ is one that is commonly held throughout the literature.<sup>35</sup> Now that I have gotten the definition of the preliminary term ‘disciplinarity’ out of the way, I can move on to its more complicated cousin ‘interdisciplinarity’ in the next paragraph.

### **Constructing a Framework for CIPI**

The term ‘interdisciplinarity’ arose in the 1970s, and quickly mutated into a number of related terms such as multi-, trans- and pluridisciplinarity.<sup>36</sup> Through this new discussion in the 1970s and 1980s, a common theoretical picture of what is usually meant by the term

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<sup>32</sup>Uskali Mäki. “Scientific Imperialism: Difficulties in Definition, Identification, and Assessment,” *International Studies in the Philosophy of Science* 27, no. 3 (September 2013): 335. <https://doi.org/10.1080/02698595.2013.825496>.

<sup>33</sup> Uskali Mäki, Adrian Walsh, and Manuela Fernández Pinto (eds.), *Scientific Imperialism: Exploring the Boundaries of Interdisciplinarity*, Routledge Studies in Science, Technology and Society 36. (London ; New York: Routledge, Taylor & Francis Group, 2018), 2-3.

<sup>34</sup>Svenja Matusall, Ina Maria Kaufmann and Markus Christen, “The Emergence of Social Neuroscience as an Academic Discipline,” In *The Oxford Handbook of Social Neuroscience* Jean Decery and John T. Cacioppo eds. (Oxford: Oxford University Press, 2011), 10-11 <https://doi.org/10.1093/oxfordhb/9780195342161.013.0002>.

<sup>35</sup> Hanne Andersen, “Collaboration, Interdisciplinarity, and the Epistemology of Contemporary Science,” *Studies in History and Philosophy of Science Part A* 56 (April 2016): 2-5. <https://doi.org/10.1016/j.shpsa.2015.10.006>; Jan Cornelius Schmidt, “Philosophy and plurality: providing a classification and clarification of interdisciplinarity,” In *Philosophy of Interdisciplinarity: Studies in Science, Society and Sustainability* 1st ed. (London: Routledge, 2021), 24-26 <https://doi.org/10.4324/9781315387109>; Lattuca, Lisa R. *Creating Interdisciplinarity: Interdisciplinary Research and Teaching among College and University Faculty* 1. ed. Vanderbilt Issues in Higher Education. (Nashville, Tenn: Vanderbilt University Press, 2001), 1-10.

<sup>36</sup> Julie Thompson Klein, “3 Typologies of Interdisciplinarity: The Boundary Work of Definition,” In *The Oxford Handbook of Interdisciplinarity* Robert Frodeman ed. (online edn, Oxford Academic, 2017), 21 <https://doi.org/10.1093/oxfordhb/9780198733522.001.0001>.

‘interdisciplinarity’ emerged within the philosophy of science.<sup>37</sup> It is this ‘classical’ picture that I will attempt to recreate here. The three main characteristics I will describe are respectively: a commitment to integration/unification, explanatory reductionism as a way to achieve this integration/unification, and the requirement that the disciplines involved in such an interaction communicate extensively.

### *Integration and unification*

As the word ‘integrative’ in its name indicates, the classical integrative picture of interdisciplinarity is defined by ‘integration’. As Lisa Lattuca points out in her book *Creating Interdisciplinarity*, ‘disciplinary integration’ is what most philosophers of science mean when they use the word ‘interdisciplinarity’.<sup>38</sup> But what is integration? Although the term is used quite frequently within the literature, finding a consistent definition is no easy feat. One of the few philosophers who has attempted a clarification of what is meant by ‘integration’ is Todd A. Grantham. Grantham connects the notion of integration to the ideal of the unity of science and uses the terms ‘integration’ and ‘unification’ interchangeably.<sup>39</sup> It is a commonly held ideal within science that the unification of scientific knowledge is one of its epistemic aims and that achieving unity is a ‘good thing’. The Vienna Circle logical positivists, for example, considered the unification of the sciences as one, as an operative ideal.<sup>40</sup> Grantham himself brings up the example of Newton who unified both celestial and terrestrial physics. Instead of constructing two different theories which each described their own part of the world, Newton formulated a type of physics that could unify both realms and thereby unified the two types of mechanics.<sup>41</sup> I would say that by unifying both terrestrial and celestial phenomena Newton integrated the two existing types of physical theory into a single encompassing theory.

### *Explanatory reductionism and multilevel theories*

Integration and unification seem to be closely related ideals, but what exactly is meant here by the word ‘unification’? Luckily, Grantham can be of help here as well. In his explanation of unification/integration Grantham goes on to say that what is most commonly meant by the unification (or integration) of scientific domains is what he calls ‘unity as reduction’.<sup>42</sup>

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<sup>37</sup> Lisa R. Lattuca, *Creating Interdisciplinarity: Interdisciplinary Research and Teaching among College and University Faculty*. 1. ed. Vanderbilt Issues in Higher Education. (Nashville, Tenn: Vanderbilt University Press, 2001), 10.

<sup>38</sup> Lisa R. Lattuca, *Creating Interdisciplinarity*, 10-15.

<sup>39</sup> Todd A. Grantham, “Conceptualizing the (Dis)Unity of Science,” *Philosophy of Science* 71, no. 2 (April 2004): 133–134. <https://doi.org/10.1086/383008>.

<sup>40</sup> Jordi Cat, "The Unity of Science," *The Stanford Encyclopedia of Philosophy* (Spring 2023 Edition), Edward N. Zalta & Uri Nodelman (eds.), URL = <<https://plato.stanford.edu/archives/spr2023/entries/scientific-unity/>>.

<sup>41</sup> Todd A. Grantham, “Conceptualizing the (Dis)Unity of Science,” 133-134.

<sup>42</sup> Todd A. Grantham, “Conceptualizing the (Dis)Unity of Science,” 135-136.

Reduction, as most notably characterized by Ernest Nagel, is the act of translating a theory B (TB) into a theory A (TA) by using certain bridging principles that allow for the translation of the terms within TB to TA. In this scenario, TA is a theory about more basic terms than theory B, which means that one can say that theory TB reduces to TA.<sup>43</sup> An illuminating example that I can use to clarify this idea is the relationship between thermodynamics and statistical mechanics. Before statistical mechanics was founded, physicists developed theories of thermodynamics describing the physics of heat. In this theory, heat was seen as its own entity, and laws were formulated in terms of this abstract object of 'heat'. However, with the emergence of the field of statistical mechanics, which studies the movements of large numbers of particles, it was discovered that what had previously been called 'heat', could be described as the average velocity of the particles in a substance. As it turns out the theories of classical thermodynamics can therefore be reduced, or translated to the more fundamental theory of statistical mechanics, uniting both theories into a new unified theory of thermodynamics.<sup>44</sup>

There are, however, different types of reductionism, some more, and others less radical. For the construction of my CIPI, I will be referring to a specific form of reduction that I term 'explanatory reduction'. In the case of explanatory reduction, the interpretation of the statement 'reduces to' in the statement 'TB reduces to TA' entails an explanatory relationship. By reducing TB to TA, I have in some sense explained TB. To put it in terms of my example, by saying that heat reduces to particle velocity, I have scientifically explained the concept of heat. I am however not saying that 'heat is ontologically the same as the velocity of particles'. In my 'explanatory reduction,' both levels of analysis are an important part of the full explanation of heat. In practice, I require 'explanatory reduction' within a CIPI-type interaction to lead to the construction of multilevel theories, where the theories of one discipline on a higher level of analysis can be translated to one on a lower level of analysis through bridging principles. For the sake of my future analysis, I will say that any integrative theory that is dismissive towards the higher levels of analysis concerned, cannot properly be called a theory that follows the CIPI.

#### *Disciplinary communication: multidisciplinary vs interdisciplinary*

Along with the theoretical characteristics of integration/unification and explanatory reductionism, I take there to be another more 'practical' requirement to complete my picture of

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<sup>43</sup> Raphael van Riel and Robert Van Gulick, "Scientific Reduction," *The Stanford Encyclopedia of Philosophy* (Spring 2019 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/spr2019/entries/scientific-reduction/>.

<sup>44</sup> Roman Frigg and Charlotte Werndl, "Philosophy of Statistical Mechanics," *The Stanford Encyclopedia of Philosophy* (Summer 2023 Edition), Edward N. Zalta & Uri Nodelman (eds.), <https://plato.stanford.edu/archives/sum2023/entries/statphys-statmech>.

CIPI. In her definition of what is most commonly understood by interdisciplinarity, Lattuca mentions “communication between the different disciplines involved” as an important indicator of classic interdisciplinarity.<sup>45</sup> In a CIPI interaction, both disciplines acknowledge each other, and their joint contributions to the study of the studied phenomenon. Representatives from both disciplines come together to jointly discuss how these unifying multilevel theories are to be created and each has an equal say within the interdisciplinary collaboration. This is a characteristic that furthermore enables me to differentiate between ‘interdisciplinarity’, and its cousin ‘multidisciplinarity’. Within multidisciplinary interactions, there is no communication between the theories involved in the interaction. This lack of communication also manifests as the absence of a unificatory/integrative impulse in the interaction and the absence of multilevel theories constructed through explanatory reductionism. Within multidisciplinary interactions, different disciplines contribute their own specialized knowledge to a common phenomenon, but no actual exchange between these different disciplines occurs.<sup>46</sup> Furthermore, no claim to such communication or exchange is made. Very briefly put: when a phenomenon is a multidisciplinary field of study the disciplines involved ignore each other.

### *Representing CIPI*

This distinction between multi- and interdisciplinarity leads me to a summarizing graphic representation of the CIPI conceptualization of disciplinary interaction. (Figure 1). In this figure, I have divided disciplinary interactions into multidisciplinary and classical integrative interdisciplinarity. The view of disciplinary interaction that comes with CIPI is one that can be represented through a binary between multidisciplinary and interdisciplinarity. I am not saying that no author has attempted a more nuanced picture of disciplinary interaction, but for my construction of CIPI, this representation will do. As we can see disciplinary interaction either falls into the category of CIPI, where unification/integration and extensive collaboration are taking place, or in the multidisciplinary category, where there is no exchange at all. There seems to be little room for nuance. In this picture, there are only two types of disciplinary relationships, only one of which, namely the CIPI which can properly be called ‘interdisciplinarity’. Either a disciplinary interaction fulfills the conditions to be called CIPI, or it is not an ‘interdisciplinary’ interaction. As I will show when looking at the specifics of my case study, this rigidity has consequences for its applicability to scientific practice. Reality rarely tends to fall into neat

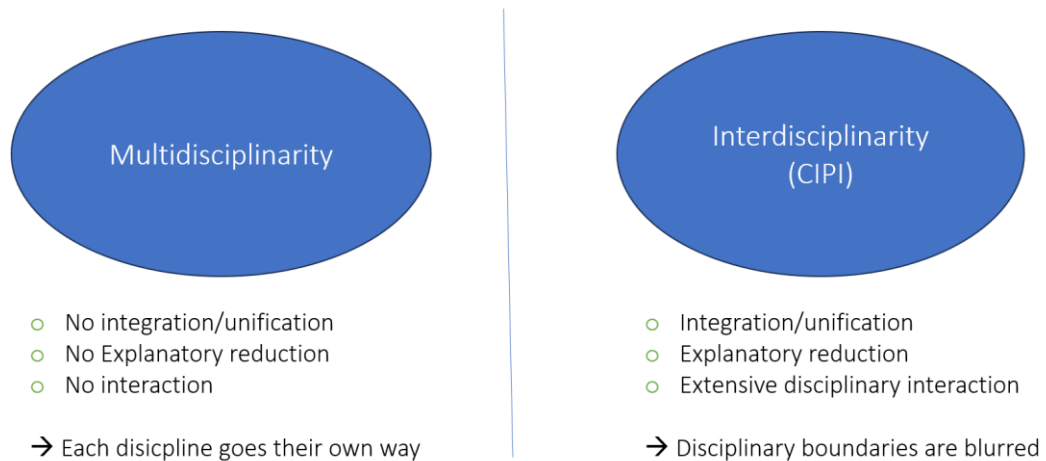
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<sup>45</sup> Lisa R. Lattuca, *Creating Interdisciplinarity: Interdisciplinary Research and Teaching among College and University Faculty*. 1. ed. Vanderbilt Issues in Higher Education. (Nashville, Tenn: Vanderbilt University Press, 2001), 12-14.

<sup>46</sup> Ibid.

binaries, and the meaning of ‘interdisciplinarity’ in theory will turn out to differ from interdisciplinarity in practice, but more about this in the next chapters.

### The CIPI view of disciplinary interactions



**Figure 1:** The CIPI view of interdisciplinary interaction can simplistically be represented as a binary between multidisciplinarity and interdisciplinarity. Both forms of disciplinary interaction have conflicting characteristics resulting in a complete lack of acknowledgment between disciplines for multidisciplinarity and the blurring of disciplinary boundaries within CIPI-interdisciplinarity.

### Social Neuroscience as an embodiment of CIPI

Now that I have shown how philosophers conceptualize ‘interdisciplinarity’ as CIPI, I can move on to a scientific discipline that by its own admission should exemplify such an ideal of interdisciplinarity. Social neuroscience is a discipline that is defined by its practicing scientists as an interdisciplinary collaboration between social psychology and neuroscience. As it turns out CIPI is not only a theoretical ideal within philosophy but also a crucial part of the self-conceptualization of an actual science. In what follows I will provide the reader with some context in the form of the establishment of social neuroscience as a discipline, which will then lead me to prove that the scientists involved in its construction, conceived of the discipline as interdisciplinary in the CIPI style. After this, I will focus on a specific component of this field, namely mirror neuron empathy, which is an integral part of its history and I will therefore take as representative of the field throughout this thesis.

#### *A terminological note*

Before starting my discussion of the disciplinary history of social neuroscience, I need to briefly address a terminological issue. In certain publications I have used, the authors refer to the

discipline I'm describing as 'social neuroscience', while in others the more specific term 'social cognitive neuroscience' is used. As can be deduced from the terminology, 'social neuroscience' is the more general term of the two, 'social cognitive neuroscience' being a subdiscipline of social neuroscience. Hence my use of the word 'social neuroscience' will refer to both terms. Furthermore, I will not stress any real distinction between the terms as most psychology at the time was conducted within a 'cognitivist' framework following the cognitive revolution in the second half of the 20<sup>th</sup> century.<sup>47</sup> Moreover, the term 'cognitive' is oftentimes used in opposition to the descriptor 'affective', but this divide between cognitive and affective psychology and neuroscience was precisely being challenged by social neuroscientific research.<sup>48</sup> It is for these reasons that I will consider social neuroscience and social cognitive neuroscience as one entity in the remainder of this chapter.

### *A Brief Disciplinary History of Social Neuroscience*

There is no easily fixed starting point for the birth of any discipline, but looking back, certain key developments and papers can retroactively be identified as important markers. According to Lieberman in his paper *A Geographical History of Social Cognitive Neuroscience*, the first mention of the human brain as a social entity can be traced back to 1985 when Michael Gazzaniga published the book *The Social Brain*.<sup>49</sup> In this work, Gazzaniga proposes the following radical insight: "Metaphorically, we humans are more of a sociological entity than a single unified psychological entity. We have a social brain".<sup>50</sup> At the time most neuroscientists were concerned with the cognitivist idea of the brain as a solitary unit of computation. Contrary to this, Gazzaniga argues that studies of the brain could offer insight into social phenomena such as human culture, religion, etc., and that it is up to neuroscientists to clarify this link.<sup>51</sup> It would, however, not be until 1992, the very same year mirror neurons were discovered, that the term 'social neuroscience' was coined by Cacioppo and Bernstein. In their article, *Social Psychological Contributions to the Decade of the Brain*, Cacioppo, and Bernstein similarly argue that neuroscience needs to acknowledge the existence of the brain as a social entity. This

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<sup>47</sup> Michael I. Posner and Gregroy J. DiGirolamo, "Cognitive Neuroscience: Origins and Promise," in *Psychological Bulletin* Vol. 126, No.6 (2000), 874-875.

<sup>48</sup> Richard J. Davidson "Cognitive Neuroscience Needs Affective Neuroscience (and Vice Versa)," *Brain and Cognition* 42, no. 1 (February 2000): 89–92. <https://doi.org/10.1006/brcg.1999.1170>; Jaak Panksepp, "At the Interface of the Affective, Behavioral, and Cognitive Neurosciences: Decoding the Emotional Feelings of the Brain," *Brain and Cognition* 52, no. 1 (June 2003): 4–14. [https://doi.org/10.1016/S0278-2626\(03\)00003-4](https://doi.org/10.1016/S0278-2626(03)00003-4).

<sup>49</sup> Matthew D. Lieberman, "A Geographical History of Social Cognitive Neuroscience," *NeuroImage* 61, no. 2 (June 2012): 432.

<sup>50</sup> Michael S. Gazzaniga, *The Social Brain: Discovering the Networks of the Mind*, (New York: Basic Books, Inc., Publishers, 1985), x.

<sup>51</sup> Michael S. Gazzaniga, "The Social brain," x.



article is oftentimes taken as a starting point for the discipline of social neuroscience, and in it, the authors call for cooperation between the fields of social psychology and neuroscience to create a complete interdisciplinary multilevel account of human behavior.<sup>52</sup>

The title of this article also hints at an important contextual factor that contributed to the broadening of neuroscientific research in the 1990s, namely ‘the Decade of the Brain’. In 1990, President Bush signed a resolution declaring that both basic and applied neuroscientific research should be encouraged in the decade to come. Significant amounts of funding were made available, and this gave an impulse to not only American neuroscientific research but also boosted research in Europe.<sup>53 54</sup> The Decade of the Brain meant that more neuroscientific research could be conducted and that the expansion of its boundaries was to be encouraged. There was hope that neuroscientific research would take great leaps that would translate into useful applications.<sup>55</sup> Coincidentally a bibliometric analysis of social cognitive neuroscience by Matusall et al. suggests that the starting point of the discipline can be situated in the 90s, while it became popular in the late 90s.<sup>56</sup> But funding and enthusiasm alone are not enough for scientific success, and as Matusall et al. mention, other internal innovations within the field of neuroscience contributed to this rising interest in the social domain. One of the most important developments is the emergence of new neuroimaging technologies.<sup>57</sup> Around the mid-90s, functional imaging technologies, such as the functional magnetic resonance imaging (fMRI) and electroencephalogram (EEG) were perfected and could be used to observe the human brain in action.<sup>58</sup>

Although the first developments of social neuroscience research can be situated in the 90s, it was not until the beginning of the new millennium that certain milestones for disciplinary

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<sup>52</sup> John T. Cacioppo and Gary G. Berntson, “Social Psychological Contributions to the decade of the brain: Doctrine of Multilevel Analysis,” *American Psychologist* Vol .47, No. 8 (1992), 1019-1028; Svenja Matusall, Ina Maria Kaufmann and Markus Christen, “The Emergence of Social Neuroscience as Academic Discipline,” in *The Oxford Handbook of Social Neuroscience* Jean Decery and John T. Cacioppo eds. (Oxford: Oxford University Press, 2011) 10. <https://doi.org/10.1093/oxfordhb/9780195342161.013.0002>.

<sup>53</sup> Marcia Meldrum, Joel Braslow and Rena Selya, “Celebrating 50 years of neuroscience progress: A history of the Society for Neuroscience,” (Washington: The Society for Neuroscience, 2021), 69.

<sup>54</sup> Wolf Singer and Sascha Topp, “Neuroscience History Interview with Professor Wolf Singer, Emeritus Director at the Department of Neurophysiology, Max Planck Institute for Brain Research in Frankfurt Am Main,” *Journal of the History of the Neurosciences* 32, no. 2 (3 April 2023): 152. <https://doi.org/10.1080/0964704X.2021.1904714>.

<sup>55</sup> Murray Goldstein, “The Decade of the Brain,” *Neurology* 40, no. 2 (1990): 321; DOI: 10.1212/WNL.40.2.321

<sup>56</sup> Svenja Matusall, Ina Maria Kaufmann and Markus Christen, “The Emergence of Social Neuroscience as an Academic Discipline,” 18.

<sup>57</sup> Svenja Matusall, Ina Maria Kaufmann and Markus Christen, “The Emergence of Social Neuroscience as an Academic Discipline,” 17.

<sup>58</sup> Kevin N. Oschner and Matthew D. Lieberman, “The Emergence of social Cognitive Neuroscience,” *American Psychologist* Vol. 56, No. 9 (2001), 718.



formation began to be reached. In April 2001, the very first social (cognitive) neuroscience convention was held at UCLA.<sup>59</sup> Following this, Oschner and Lieberman published a paper *The Emergence of Social Cognitive Neuroscience*, in which they explicitly state some of the core disciplinary aims and outline some main points of interest, but more about this article later on.<sup>60</sup> Starting in 2003 multiple journals began publishing issues centering around social neuroscience. Next came the 2004 establishment of the University of Chicago Center for Cognitive and Social Neuroscience, with an accompanying specialized conference.<sup>61</sup> Following this, a first handbook for social neuroscience was created in 2005, further cementing the discipline's legitimacy.<sup>62</sup> That same year a workshop was held by the National Institute of Mental Health to explicitly discuss the scope and program of the new field.<sup>63</sup> Unbeknownst to each other Matthew Lieberman and Jean Decety, two prominent social neuroscientists had been working on the next big leap in disciplinary formation, namely the establishment of a dedicated journal. 2006 saw the appearance of both SCAN (Social Cognitive and Affective Neuroscience) and SN (Social Neuroscience), respectively edited by Lieberman and Decety.<sup>64</sup> Subsequently, a yearly conference for Cognitive and Social Neuroscience started taking place in 2007, and finally, the International Interdisciplinary Society for Neuroscience was established in 2010.<sup>65</sup>

#### *Social neuroscience as a CIPI interaction between social psychology and neuroscience*

A notable characteristic of this newly emerging discipline of social neuroscience is its commitment to embodying a CIPI-type of interdisciplinary interaction. By using publications outlining the disciplinary aims and ideals of social neuroscientists in their creation and conceptualization of their discipline I will show that, in theory, the field of social neuroscience is characterized by a classic integrative interdisciplinary interaction between social psychology and neuroscience. Although other social sciences are sometimes referred to within these

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<sup>59</sup> Kevin N. Oschner and Matthew D. Lieberman, "The Emergence of social Cognitive Neuroscience," 728.

<sup>60</sup> Kevin N. Oschner and Matthew D. Lieberman, "The Emergence of social Cognitive Neuroscience," 727.

<sup>61</sup> Svenja Matusall, Ina Maria Kaufmann and Markus Christen, "The Emergence of Social Neuroscience as an Academic Discipline," 20.

<sup>62</sup> Svenja Matusall, Ina Maria Kaufmann, and Markus Christen, "The Emergence of Social Neuroscience as an Academic Discipline," 11.

<sup>63</sup> Svenja Matusall, Ina Maria Kaufmann and Markus Christen, "The Emergence of Social Neuroscience as an Academic Discipline," 13; Cacioppo, John T et al., "Social Neuroscience: Progress and Implications for Mental Health," *Perspectives on Psychological Science* 2, no. 2 (June 2007): 99–123. <https://doi.org/10.1111/j.1745-6916.2007.00032.x>.

<sup>64</sup> Matthew D Lieberman, "Social Cognitive and Affective Neuroscience: When Opposites Attract," *Social Cognitive and Affective Neuroscience* 1, no. 1 (1 June 2006): 1–2. <https://doi.org/10.1093/scan/nsl010>; Decety, Jean, and Julian Paul Keenan, "Social Neuroscience: A New Journal," *Social Neuroscience* 1, no. 1 (March 2006): 1–4. <https://doi.org/10.1080/17470910600683549>; Matthew D Lieberman, "A Geographical History of Social Cognitive Neuroscience," *NeuroImage* 61, no. 2 (June 2012): 435. <https://doi.org/10.1016/j.neuroimage.2011.12.089>.

<sup>65</sup> Svenja Matusall, Ina Maria Kaufmann and Markus Christen, "The Emergence of Social Neuroscience as an Academic Discipline," 20-21.

publications, I take the interaction with social psychology to be of primary importance for my description.

The first relevant article here is ‘Social Psychological Contributions to the Decade of the Brain: Doctrine of Multilevel Analysis’ by John T. Cacioppo and Gary G. Berntson.<sup>66</sup> As already mentioned in a previous paragraph, this is the first article that mentions the term ‘social neuroscience’. Cacioppo and Berntson are both influential neuroscientists and were instrumental in establishing social neuroscience as a discipline. In this article, they put forward the idea of social neuroscience as an interdisciplinary endeavor with what they call “an integrative multilevel approach”. The social psychological level of analysis, operating in terms of concrete human social behavior, and the neuroscientific level, which uses the language of neurons and neurophysiology, should be combined to achieve the most accurate picture of human social behavior. Connections between these two levels of analysis should be made through theoretical links and collaborative effort.<sup>67</sup> The idea is that the knowledge acquired on one level of analysis can be useful to and influence research on a different level of analysis. An example used in their article is that of research into drug addiction. One can study the neurochemical reactions that are responsible for dependency on a substance, but these abstract physiological factors can never provide us with a complete picture of drug addiction if social and psychological factors are not also taken into account. The overarching idea articulated by the authors can be summarized as follows: “The point is that distinct levels of analysis might better be viewed as complementary, rather than alternative approaches.”<sup>68</sup> Far from dismissing higher levels of analysis, the different perspectives enrich each other and are each an important part of the puzzle. In other words, Cacioppo and Bernstein’s hopes for their discipline can be described in the following CIPI terms: social neuroscience consists of a unification/integration of the disciplines of social psychology and neuroscience, which will result in multilevel theories constructed through explanatory reduction. These different levels of analysis are equally important and the construction of these multilevel theories has to be achieved through extensive collaboration with social psychologists.

Almost a decade later Kevin N. Oschner and Matthew D. Lieberman, two active members of the field, published their 2001 review of the field outlining its progress and future

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<sup>66</sup> John T. Cacioppo and Gary G. Berntson, “Social Psychological Contributions to the decade of the brain,” 1019-1028.

<sup>67</sup> John T. Cacioppo and Gary G. Berntson, “Social Psychological Contributions to the decade of the brain,” 1021.

<sup>68</sup> John T. Cacioppo and Gary G. Berntson, “Social Psychological Contributions to the decade of the brain,” 1022.

direction. In ‘The Emergence of Social Cognitive Neuroscience’, Oschner and Lieberman largely stick to the vision set out by Cacioppo and Bernstein. Again the idea is that social (cognitive) neuroscience is a multilevel interdisciplinary endeavor. In order to create a complete picture of social behavior these different levels of analysis need to be integrated: “One premise of the social cognitive neuroscience approach is that the different questions asked by social psychologists and cognitive neuroscientists are not independent or mutually exclusive but can serve to enrich one another.”<sup>69</sup> The authors point to the emergence of collaborations between social psychologists and neuroscientists and offer hope that these endeavors might grow in the next years, the ideal again being the integration of both disciplinary perspectives.<sup>70</sup> The closing statement of their paper further indicates this ideal of unification and integration of both disciplines:

“From the social cognitive neuroscience perspective, each approach provides a necessary but individually insufficient piece of a bigger psychological puzzle. By joining forces, social psychologists and cognitive neuroscientists will no longer be strangers passing on the street but colleagues walking toward a brighter future.”<sup>71</sup>

Again, communication, integration/unification and multilevel explanatory reduction are three main characteristics of the disciplinary self-conceptualization, making social neuroscience a perfect candidate for a CIPI interaction between social psychology and neuroscience in practice.

Similar ideas are also echoed in the first editions of SCAN and SN, the first two journals exclusively publishing social neuroscience. In the introduction to the first issue of *Social Cognitive and Affective Neuroscience*, its writer and editor in chief Lieberman, is very explicit about his hopes for deeper interdisciplinary interaction between neuroscience and the social sciences in general. Lieberman explicitly asks that neuroscientists publishing in his journal connect any neuroimaging studies to existing social scientific theories.<sup>72</sup> A real effort to create CIPI-type interdisciplinary theories seems to be made, judging by statements like the following:

“Although the social sciences and neurosciences have been hugely successful enterprises in their own right, there is a sense that we can now build an intellectual superhighway between them that will allow

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<sup>69</sup> Kevin N. Oschner and Matthew D. Lieberman, “The Emergence of social Cognitive Neuroscience,” 719.

<sup>70</sup> Kevin N. Oschner and Matthew D. Lieberman, “The Emergence of social Cognitive Neuroscience,” 718.

<sup>71</sup> Kevin N. Oschner and Matthew D. Lieberman, “The Emergence of social Cognitive Neuroscience,” 729.

<sup>72</sup> Matthew D. Lieberman, “Social Cognitive and Affective Neuroscience: When Opposites Attract,” *Social Cognitive and Affective Neuroscience* 1, no. 1 (1 June 2006): 1, <https://doi.org/10.1093/scan/nsl010>.

us to catalyze the insights from both into a new kind of science that will yield important insights into the basic nature of the human mind”.<sup>73</sup>

In his introduction to *Social Neuroscience* Jean Decety, the editor-in-chief and renowned neuroscientist, expresses excitement surrounding the collaboration between social psychology and neuroscience specifically:

“Guiding social neuroscience research, whatever one chooses as the definition, should be our desire to understand the complex and dynamic relationship between the brain (and its related systems) and social interaction. Historically, these fields (i.e., neuroscience and social psychology) would weakly interact, with few formal ties between the two. However, and not unnoticed by ourselves or our suspected readership, when the fields do combine, the resulting research is inevitably exciting and meaningful, not just to academics, but to the general public as well.”<sup>74</sup>

Clearly, the idea behind establishing social neuroscience as a discipline was one of extensive interdisciplinary communication between the fields of neuroscience and social psychology. An integrative approach to human behavior by bridging both disciplines through explanatory reductionistic reasoning was, in theory, a main aim within the discipline. In my view, the discussion of the articles above clearly shows that the abstract ideal that social neuroscientists had for their field coincides with a CIPI-type interaction between social psychology and neuroscience.

#### *Mirror Neuron empathy as a case study for social neuroscience*

It would seem that social neuroscience is a prime candidate for a representative of a discipline exhibiting a CIPI-type of interdisciplinarity. The CIPI ideal held up in theory by philosophers seems to coincide with the self-concept of the scientists involved in the practice of this discipline. Describing the interaction between social psychology and neuroscience in the establishment of social neuroscience should therefore be possible in terms of CIPI. It would however be impossible to give an overview of the entire discipline, and as I have already indicated in the introduction, I will be focusing on one representative case study, namely the emergence of mirror neuron empathy. This allows me to focus specifically on the disciplinary interaction between social psychology and neuroscience in the emergence of mirror neuron empathy. In what follows I will show that mirror neuron empathy is a representative and important part of the emergence of social neuroscience. In doing this I will justify my use of

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<sup>73</sup> Matthew D. Lieberman, “Social Cognitive and Affective Neuroscience: When Opposites Attract,” *Social Cognitive and Affective Neuroscience* 1, no. 1 (1 June 2006): 1, <https://doi.org/10.1093/scan/nsl010>.

<sup>74</sup> Jean Decety and Julian Paul Keenan, “Social Neuroscience : A New Journal,” *Social Neuroscience* 1, no. 1 (March 2006): 1 <https://doi.org/10.1080/17470910600683549>.

mirror neuron empathy as a case study for the interdisciplinary interaction between social psychology and neuroscience in the establishment of social neuroscience.

In *A Geographical History of Social Cognitive Neuroscience* Matthew Lieberman, editor-in-chief of SCAN, identifies mirror neuron research as one of the most important developments in the emergence of social neuroscience. Furthermore, he identifies ‘mirror neurons’ and ‘empathy’ as characteristic features of ‘European social neuroscience’.<sup>75</sup> Lieberman explains that during the 90s research surrounding theory of mind was one of the main points of interest within the field, and pinpoints the Parma research team’s lab as one of the most important labs in the development of the discipline. In Lieberman’s words, the Parma lab was one of the labs that “set the stage for the two neurocognitive models of social cognition dominant to this day.”<sup>76</sup>

A similar picture is painted in *The Emergence of Social Neuroscience as an Academic Discipline* by Matusall et al., where alongside the development of new technologies and methods, the discovery of mirror neurons is mentioned as one of the main innovations that led to the development of social neuroscience.<sup>77</sup> More specifically, they propose that mirror neurons were “an important third step towards conceptualizing and, in particular, popularizing the social brain and its capacities like theory of mind or empathy, two prominent topics in social neuroscience.”<sup>78</sup>

Furthermore, I’d like to refer the reader to the introduction, where I have shown the dramatic growth in the popularity of mirror neuron empathy research. Added to this is the enthusiastic public reception of mirror neuron empathy in popular culture and science. With this in mind, I would venture to say that mirror neurons could be seen as a big player in both the academic, and public conceptualization of social neuroscience. Therefore, I believe it is fair to say that mirror neuron research in general, mirror neuron empathy, and specifically the Parma team’s research can be seen as an important and even representative field of research within social neuroscience.

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<sup>75</sup> Matthew D Lieberman, “A Geographical History of Social Cognitive Neuroscience,” *NeuroImage* 61, no. 2 (June 2012): 434. <https://doi.org/10.1016/j.neuroimage.2011.12.089>.

<sup>76</sup> Matthew D Lieberman, “A Geographical History of Social Cognitive Neuroscience,” 433.

<sup>77</sup> Svenja Matusall, Ina Maria Kaufmann and Markus Christen, “The Emergence of Social Neuroscience as an Academic Discipline,” 17.

<sup>78</sup> Svenja Matusall, Ina Maria Kaufmann and Markus Christen, “The Emergence of Social Neuroscience as an Academic Discipline,” 17-18.

*What should a CIPI social neuroscience theory of empathy look like*

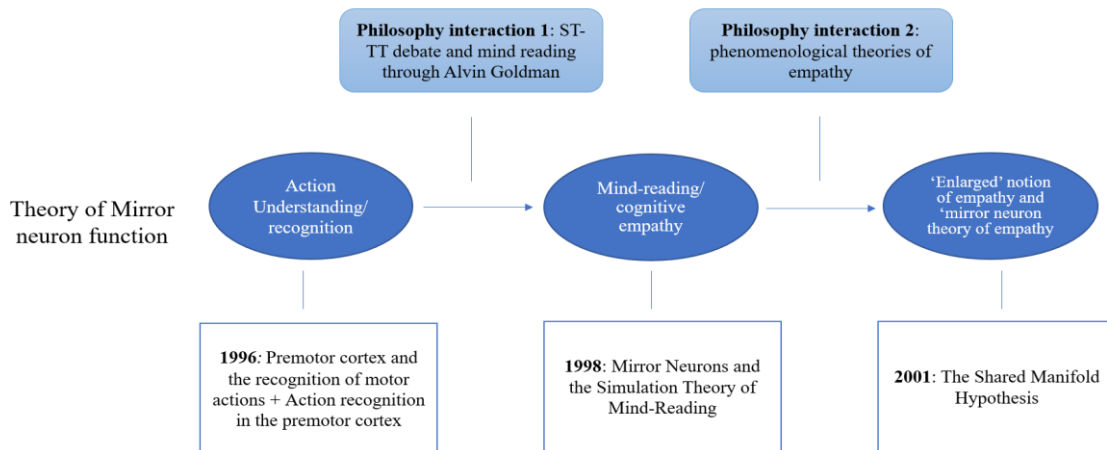
Now that I have described social neuroscience as a scientific discipline that upholds and is supposed to represent the theoretical ideal of CIPI in practice, I want to sketch a brief picture of what this implies for my case study. In theory, a social neuroscientific theory of empathy should be a CIPI interaction between the fields of neuroscience and social psychology. Through intensive collaboration and interaction, neuroscientists would have been able to move from the domain of the singular human mind to the domain of the social human mind. This collaboration would have led to an encompassing multilevel theory that includes and does justice to both levels of analysis. Social psychological theories and neuroscientific theories should be unified or integrated through the construction of theoretical bridges through explanatory reduction. Neither of the levels of analysis should be favored institutionally or epistemically and both neuroscientists and social psychologists should have been involved in the construction of the discipline. Furthermore, theories of mirror neuron empathy which came after the initial proposal should follow the same guidelines.

With this theoretical picture in mind, I can now move on to the next chapter, in which I will present the practical reality of the development of mirror neuron empathy. As it will turn out, the theoretical picture I painted above does not quite fit the historical reality.

## Chapter 2 The emergence of mirror neuron empathy in practice

The road from the initial discovery of mirror neurons, to mirror neurons as a basic building block of empathy was not straightforward. In this chapter, I will present a history of how the first theory of mirror neuron empathy was formulated in practice. I will show how the Parma team started with the idea of mirror neurons underlying action understanding, and how this initial interpretation was extended by Vittorio Gallese to first include mind-reading, and ultimately empathy. My position is that this evolution is the result of a significant interdisciplinary interaction of neuroscience with the field of philosophy (Figure 1). First, through a collaboration between Gallese and philosopher of mind Alvin Goldman, who entered mirror neuron theory into the philosophical mind-reading debate between theory-theory versus simulation theory. Secondly, through the influence of phenomenology, whose concept of empathy Gallese connected with mirror neurons. I believe this interchange was possible because the specific philosophical domains Gallese interacted with, were already interacting significantly with neuroscience. This will ultimately lead me to illuminate Gallese's 'mirror neuron theory of empathy'. This mirror neuron empathy was later carried forth by Keysers and Iacoboni, who firmly entrenched mirror neurons as a basis for empathy within the domain of social neuroscience.

Aside from functioning as my case study, this detailed description is also a history of this development, reconstructed through a careful selection of the primary literature published by the Parma team, and their successors. I will argue that this history shows that mirror neuron empathy does not conform to the theoretical expectation I described at the end of the previous chapter. The emergence of mirror neuron empathy cannot be described as a CIPI-style interdisciplinarity between social neuroscience and social psychology. Instead mirror neuron empathy emerged through interactions with philosophy, which ultimately allowed neuroscience to circumvent interaction with social psychology in the construction of its theory.



**Figure 1:** interactions with philosophy which led to the creation of mirror neuron empathy citing the relevant papers on the bottom and the interactions between neuroscience and philosophy on the top.

### The initial interpretation: Action understanding

To understand how the Parma researchers came by their first interpretation of mirror neuron function, I have to move back in time to shed some light on what the team was originally investigating when they happened upon their discovery. This takes me back to a 1988 publication that cites Giacomo Rizzolatti as its head researcher. In this article the possible function of the F5 region, wherein mirror neurons were later found, is discussed, giving us an insight into the functional role of this region.<sup>79</sup> At the time it was generally thought that neurons in F5 were involved in the coding of simple movements. This type of command could, for example, be ‘extend your arm or ‘open your fist’, but would not include a more abstract order such as ‘grab this mug’. This last example is what neuroscientists would call an action. Actions are composed of single movements such as ‘extend your arm’ and ‘close your fist’, but are unified into an action by a specific end-goal which is kept in mind by the person executing the action, for example grabbing a mug. In other words, actions have specific intentions kept in mind by whoever is performing the action.<sup>80</sup> The main point of the 1988 article was to upset the common understanding of the F5 region as only coding simple movement, and to propose that F5 is involved in the coding of the more abstract actions. This proposal was brought on by the observation that certain neurons in F5 would start firing before any movement was performed, and would not stop firing until a certain goal was achieved. This meant that neural activity was

<sup>79</sup> Giacomo, Rizzolatti et al., “Functional Organization of Inferior Area 6 in the Macaque Monkey,” *Experimental Brain Research* 71 (1988): 491-507.

<sup>80</sup> *Ibid.*, 503.



happening before any actual movement, hinting at the fact that simple movement was not the only thing happening in this region. Furthermore, the same neurons would fire, regardless of exactly how the action was performed.<sup>81</sup> To return to my mug-grabbing example, the mug-grabbing neurons would fire regardless of whether the mug was grabbed with the right or left hand, once again indicating that they coded something more complex. The proposed hypothesis was that the firing of these pre-motor cortex neurons forms a vocabulary of actions, that can be activated by certain stimuli, either visual or somatosensory.<sup>82</sup> For example, if I see or feel a mug, these neurons could be activated, providing me with the option of performing the action of grabbing the mug, or if I felt the mug against my hand the same action could also become available to me. It is precisely this hypothesis that the Parma team was researching in 1992 when they accidentally first observed the activation pattern of mirror neurons.<sup>83</sup>

With this background information in mind, I can move on to the initial interpretation of mirror neuron function. After observing that mirror neurons would fire in the same pattern when observing and executing an action in 1992, the researchers could add something to their 1988 hypothesis: not only can the action vocabulary be accessed through the visual or somatosensory observation of certain objects that could be interacted with through a certain action, but it can also be activated by observing someone else performing an action. In their 1992 research note, the Parma team mention that mirror neurons might therefore be helpful in understanding the aim of actions performed by other group members. By implicitly understanding the actions of other individuals, an observer might more effectively retrieve a relevant response action. In short, not only would the pre-motor cortex help us select the relevant actions for manipulating certain types of objects, but it could also be of help in quickly selecting a relevant action within the context of interpersonal relations.<sup>84</sup>

This initial potential function of mirror neurons was still in its infancy during the first publication, and it would take some time before it was developed into what would later be called a theory of action understanding or recognition. It is in the Parma team's two 1996 publications, *Premotor Cortex and the Recognition of Motor Actions* and *Action Recognition in the Premotor Cortex*, that this interpretation is put forward in its final form.<sup>85</sup> Within these articles, the Parma

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<sup>81</sup> Ibid., 504.

<sup>82</sup> Ibid., 505-506.

<sup>83</sup> G. di Pellegrino et al., "Understanding Motor Events: A Neurophysiological Study," *Experimental Brain Research* 91, no. 1 (October 1992): 176.

<sup>84</sup> Ibid., 179.

<sup>85</sup> Vittorio Gallese et al., "Action Recognition in the Premotor Cortex," *Brain* 119, no. 2 (1996): 593-609, <https://doi.org/10.1093/brain/119.2.593>; Giacomo Rizzolatti et al., "Premotor Cortex and the Recognition of

team coined the term ‘mirror neurons’ and published a detailed account of the different properties of these cells. It is also in these articles that mirror neurons are presented as underlying action understanding or recognition.<sup>86</sup> The Parma team proposes that mirror neurons might underlie a form of action representation that determines both the performance of an action and the understanding of an action when it is merely observed. This interpretation of mirror neurons underlying action understanding is best understood through an example: When a monkey grabs a mug, the monkey’s mirror neurons light up in the very same way as when they observe another monkey grabbing this mug.<sup>87</sup> This phenomenon can be interpreted as the same abstract action vocabulary (recall the 1988 and 1992 papers) being employed for the observer’s own action, and the observation of someone else’s actions.<sup>88</sup> The monkey therefore implicitly understands what another monkey is doing when they extend their arm to grab a mug because the observing monkey’s brain matches the movement of the moving monkey to what its intention would be while performing the same movements.<sup>89</sup> It is important here to note that this type of action understanding does not imply a conscious, cognitive form of understanding. In other words, the observing monkey doesn’t think to itself ‘the moving monkey is grabbing this mug because he wants to drink from it’. Instead, this form of action understanding nearly means that the observing monkey’s brain can subconsciously interpret the actions of another monkey, without this implying a conscious rational reflection.

### **Goldman and Gallese: a first encounter between philosophy and neuroscience**

In 1998, at the second *Towards a Science of Consciousness* conference, philosopher Alvin Goldman attended a session held by Vittorio Gallese, a member of the Parma team, in which Gallese discussed the newly discovered mirror neurons. At the time mirror neurons were not yet widely known, and when Goldman heard about the curious properties of these cells, his philosophical interest was piqued. In his book *Simulating Minds*, he mentions how this encounter influenced his thinking about simulation theory.<sup>90</sup> Gallese also mentions this encounter as particularly influential and recalls Goldman asking questions during the talk and

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Motor Actions,” *Cognitive Brain Research* 3, no. 2 (March 1996): 131–41, [https://doi.org/10.1016/0926-6410\(95\)00038-0](https://doi.org/10.1016/0926-6410(95)00038-0).

<sup>86</sup> Giacomo Rizzolatti et al., “Resonance Behaviors and Mirror Neurons,” *Archives Italiennes de Biologie*, 137 (1999): 94.

<sup>87</sup> Giacomo Rizzolatti et al., “Premotor Cortex and the Recognition of Motor Actions,” 137; Vittorio Gallese et al., “Action Recognition in the Premotor Cortex,” 606.

<sup>88</sup> Vittorio Gallese et al., “Action Recognition in the Premotor Cortex,” 606-607.

<sup>89</sup> Vittorio Gallese et al., “Action Recognition in the Premotor Cortex,” 606-607; Giacomo Rizzolatti et al., “Premotor Cortex and the Recognition of Motor Actions,” 136-137.

<sup>90</sup> Alvin I. Goldman, *Simulating Minds: The Philosophy, Psychology, and Neuroscience of Mindreading*, Philosophy of Mind (Oxford ; New York: Oxford University Press, 2006), viii.

later going out to lunch with him, where Goldman introduced Gallese to the philosophical mind-reading debate and simulation theory.<sup>91</sup>

As a result of their encounter at this conference, Gallese and Goldman joined forces and published a paper together in 1998, concerning the role of mirror neurons in the phenomenon of mind reading.<sup>92</sup> Ultimately I believe that this collaboration was instrumental in nudging Gallese to first connect mirror neurons to mind-reading and ultimately to formulate a theory of empathy with mirror neurons at its base. I will discuss the articles leading up to this theory at length in the next paragraphs, but first I will illustrate how such a collaboration between a neuroscientist and philosopher, coming from two seemingly different disciplines could come to be. To accomplish this, I have to turn my attention to two relevant debates within philosophy of mind that took place in the mid-1980s which will provide some clarifying context. First I will discuss the theory-theory simulation theory (hereafter shortened to TT and ST) debate, in which Goldman played a pivotal role. Secondly, I will turn my attention to the disciplinary interplay between philosophy of mind and neuroscience around the same time and claim that philosophy of mind and neuroscience were interacting significantly around the end of the 20th century. These discussions will then help me in clarifying the collaboration between Goldman and Gallese, and therefore allow me to better understand the first important development in mirror neuron empathy history.

### *The Simulation Theory Versus Theory Theory debate*

During the mid-1980s both philosophers and developmental psychologists were involved in a lively debate surrounding the concepts of folk psychology or mind-reading. The Stanford Encyclopedia of Philosophy defines mind-reading as follows: “the capacity to represent, reason about, and respond to others’ mental states” and continues to say that “Essentially the same capacity is also known as ‘folk psychology’”.<sup>93</sup> Simply put, the central question of the debate would sound something like ‘How is it possible that we as human beings can understand or at least approximate other’s mental states?’. The roots of this philosophical discussion can be traced back to the 1950s when the analytic philosopher Wilfrid Sellars came up with the idea that our understanding of the mental state of others is theoretical in nature. In his view,

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<sup>91</sup> Vittorio Gallese, “Finding the Body in the Brain: From Simulation Theory to Embodied Simulation,” in *Goldman and His Critics* eds. Brian P. McLaughlin and Hilary Kornblith, (Hoboken: John Wiley & Sons, Inc, 2016), 297.

<sup>92</sup> Vittorio Gallese and Alvin Goldman, “Mirror Neurons and the Simulation Theory of Mind-Reading,” *Trends in Cognitive Sciences* 2, no. 12 (1998): 493-501.

<sup>93</sup> Luca Barlassina, and Robert M. Gordon, "Folk Psychology as Mental Simulation," *The Stanford Encyclopedia of Philosophy* (Summer 2017 Edition), Edward N. Zalta (ed.), URL = <<https://plato.stanford.edu/archives/sum2017/entries/folkpsych-simulation/>>.

psychological concepts could be likened to theoretical scientific concepts.<sup>94</sup> This idea was further built upon in the 70s by David Lewis who suggested that folk psychology is structured in the same way as any other scientific theory, namely consisting of psychological laws of inference.<sup>95</sup> The scientific theoretical term ‘electron’ doesn’t refer to a directly observable entity, and neither do mental terms such as ‘belief’ or ‘desire’. We understand what an electron is because we have a scientific theory that gives this term its meaning. Similarly, we understand what ‘belief’ or ‘desire’ means because we as humans possess a folk-psychological theory, complete with laws linking sensory information to mental states, mental states to other mental states, and mental states to behaviors.<sup>96</sup> For example, if I step on a nail I will have some sensory input, namely pain in my foot which is then, by a psychological law, directly related to a certain mental state, for example, a belief that I have stepped on a nail. This mental state, namely the belief I have stepped on a nail, may then be linked to other mental states, for example, anger at the person who left the nail on the ground. Finally, there would also be a behavior accompanying the belief that I stepped on a nail, for example screaming angrily. This chain of events illustrates how a folk psychology such as the one described by Lewis would function, by connecting sensory information, mental states, and behavior. It is worth mentioning that this way of accounting for internal states falls into the category of functionalist theories of mind, in which an inner state of mind is defined by its causal relations, like the laws explained above.<sup>97</sup>

Around the same time that Lewis was proposing his folk-psychological theory, Premack and Woodruff were conducting similar research within developmental psychology.<sup>98</sup> Here the question was whether chimpanzees might have a theory of mind and whether they would be able to follow a folk-psychological chain of inferences similar to the one described by Lewis.<sup>99</sup> This research was later followed up by investigations into the acquisition of this ability in children.<sup>100</sup> The results showed that children, not unlike little scientists, seemed to finetune their folk-psychological theory in incremental steps, progressively perfecting their psychological theories through trial and error.<sup>101</sup> The functionalist's approach to mind-reading therefore

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<sup>94</sup> Willem deVries, "Wilfrid Sellars," *The Stanford Encyclopedia of Philosophy* (Fall 2021 Edition), Edward N. Zalta (ed.), URL = <<https://plato.stanford.edu/archives/fall2021/entries/sellars/>>.

<sup>95</sup> Alvin Goldman, *Simulating Minds*, 7-8.

<sup>96</sup> Ian Ravenscroft, "Is folk psychology a theory?," in *The Routledge Companion to Philosophy of Psychology*, eds. John Symons and Paco Calvo, (New York: Routledge, 2009), 132.

<sup>97</sup> Alvin I. Goldman, *Philosophical Applications of Cognitive Science* (Boulder: Westview Press, 1993), 27.

<sup>98</sup> Alvin Goldman, *Simulating Minds*, 10.

<sup>99</sup> David Premack and Guy Woodruff, "Does the Chimpanzee Have a Theory of Mind?," *Behavioral and Brain Sciences* 1, no. 4 (1978): 515.

<sup>100</sup> Alvin Goldman, *Simulating Minds*, 12.

<sup>101</sup> Alvin Goldman, *Simulating Minds*, 13.

seemed to be corroborated by scientific findings, strengthening the conceptualization of folk-psychology as a scientific theory. It is this approach to mind-reading that would later become known as theory-theory (TT).

However, this so-called ‘theory-theory’ of mind-reading, would not remain unchallenged for long. In 1986 both Jane Heal and Robert Gordon published articles proposing an alternative, namely simulation theory (ST).<sup>102</sup> Gordon and Heal both claim that our capacity to understand the actions of others should not be seen as the application of a scientific theory, but instead, should be seen as a form of simulation. To understand what is on someone else’s mind, an observer would just have to watch the other individual in action and mentally place themselves in their shoes.<sup>103</sup> This would then remove the need for a high form of theoretical intellect when hypothesizing about other’s mental states. Three years later, in 1989, our very own Goldman followed suit and published *Interpretation Psychologized* in which he presents simulation theory as the basis for more complex psychological theories.<sup>104</sup> In later years, Goldman would continue to be an advocate for ST in mind-reading and is to this day one of its most influential defenders.<sup>105</sup>

What are the basic tenets of this simulation theory? Simulation theory should not be seen as a single well-defined theory. Different authors adhere to different versions, but some basic characteristics can be discerned. Firstly, according to ST theorists, it is not necessary to employ a theory to understand others. Instead, in its most basic form, we can understand the acts and mental states of others because we can simulate how we ourselves would feel in their situation by mentally simulating the same situation. It is through the use of our own decision-making mechanisms, and through using them with this pretend input that we come to understand others.<sup>106</sup> To illustrate this I can come back to the example of stepping on a nail. According to simulation theorists, I don’t understand the mental state and behaviors of someone stepping on a nail because I possess some intricate theory, but because when I see someone

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<sup>102</sup> Luca Barlassina, and Robert M. Gordon. "Folk Psychology as Mental Simulation," *The Stanford Encyclopedia of Philosophy* (Summer 2017 Edition), Edward N. Zalta (ed.), URL = <<https://plato.stanford.edu/archives/sum2017/entries/folkpsych-simulation/>>.

<sup>103</sup> Robert M. Gordon, “Folk Psychology as Simulation,” *Mind & Language* 1, no. 2 (1986): 158–7 ; Jane Heal, “Replication and Functionalism,” in *Language, Mind, and Logic*. ed. James Butterfield (Cambridge: Cambridge University Press, 1986) 135-150.

<sup>104</sup> Alvin I. Goldman, “Interpretation Psychologized,” *Mind & Language* 4, no. 3 (September 1989): 161–85. <https://doi.org/10.1111/j.1468-0017.1989.tb00249.x>.

<sup>105</sup> Luca Barlassina, and Robert M. Gordon. "Folk Psychology as Mental Simulation," *The Stanford Encyclopedia of Philosophy* (Summer 2017 Edition), Edward N. Zalta (ed.), URL = <<https://plato.stanford.edu/archives/sum2017/entries/folkpsych-simulation/>>.

<sup>106</sup> Shannon Spaulding, “Cognitive Empathy,” in *The Routledge Handbook of Philosophy of Empathy*. Ed. Heidi Maibom. 1st ed. (New York : Routledge, 2017), 15.

stepping on a nail I can internally pretend that this is happening to me by constructing an internal representation of what it would be like to step on a nail. Once I do this I might feel simulated anger and pain, which then helps me understand that the other person is feeling the same things.

In subsequent years the merits of both ST and TT were heavily debated, and the 1998 article published by Gallese and Goldman that I will discuss in the next paragraph can best be seen as a contribution to this discussion. In fact, mirror neuron research heavily influences philosophical debates of mind-reading to this day.<sup>107</sup> Interestingly, Goldman has explicitly mentioned that the Italian researchers were not familiar with this discussion before his meeting with Gallese in 1998.<sup>108</sup> It is therefore clear that Goldman was influential in the theorizing surrounding mirror neurons by introducing a link between a neuroscientific discovery and this philosophical debate.

#### *Interdisciplinary interaction between philosophy and neuroscience*

There was another development within the second half decades of the 20<sup>th</sup> century, that I find important to understand how a seemingly unlikely pair such as neuroscience and philosophy could mutually influence each other in the work of someone like Gallese. During this time philosophers working within the field of philosophy of mind were increasingly advocating for collaboration between philosophy of mind and neuroscience. This development can be seen as a consequence of the rise of physicalism, the belief that mental states are physical states.<sup>109</sup> Scientifically oriented philosophers recognized that the developments within neuroscience could not be ignored when constructing philosophical theories of mind if one recognized that mental states described within philosophy and physical states studied by science were one and the same.<sup>110</sup> A paradigmatic example of physicalism at the end of the 20<sup>th</sup> century is the 1986 publication of Patricia Churchland's book *Neurophilosophy*.<sup>111</sup> In this work Churchland argues for a unified form of brain science that encompasses both philosophy of mind and neuroscience, working together as one. According to this view, philosophers of mind should be informed by neuroscience, and in turn philosophers should have a role in structuring overarching neuroscientific theories. Philosophy of mind and neuroscience would ideally then form a single discipline, namely 'neurophilosophy', aiming to uncover the mysteries of the human mind

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<sup>107</sup> Remy Debes, "Empathy and mirror neurons," in *The Routledge Handbook of Philosophy of Empathy*. ed. Heidi Maibom. 1st ed. (New York : Routledge, 2017), 54-63.

<sup>108</sup> Alvin Goldman, *Simulating Minds*, viii.

<sup>109</sup> Amy Kind, *Philosophy of Mind : The Basics* (Abingdon Oxon: Routledge/Taylor & Francis Group, 2020), 48.

<sup>110</sup> Amy Kind, *Philosophy of Mind: The Basics*, 54.

<sup>111</sup> Ramsey, William, "Eliminative Materialism," *The Stanford Encyclopedia of Philosophy* (Spring 2022 Edition), Edward N. Zalta (ed.), URL = <<https://plato.stanford.edu/archives/spr2022/entries/materialism-eliminative/>>.

through neuroscientific theory.<sup>112</sup> Patricia Churchland and her partner Paul Churchland would later gain further attention due to their physicalist theory of eliminative materialism, which states that all our folk-psychological vocabulary will ultimately be eliminated and replaced by a completely new neuroscientific language once neuroscience has advanced enough.<sup>113</sup>

The Churchland brand of materialism is a rather extreme one, where philosophy of mind and folk-psychological language essentially become dominated by neuroscientific theory, but milder forms of mutual influence were also proposed. An example of such a philosopher is, again, our very own Goldman. In his 1993 book *Philosophical Applications of Cognitive Science* he admits that although for a long time, philosophy has been the privileged science in investigating the human mind, this is no longer true.<sup>114</sup> Instead, philosophy must take its cues from scientific approaches to the mind. Similarly, in the first chapter of *Simulating Minds* Goldman mentions how his philosophy heavily relies on scientific experimentation conducted by empirical researchers. Just like a scientist builds up theories using empirically acquired data, philosophers should be mindful of scientific discovery and integrate such findings into their theories. Furthermore, similarly to what Churchland advocates in *Neurophilosophy*, the philosopher's task is to lend a helping hand in systemizing scientific research and the overarching theories and by maintaining an overarching perspective on both disciplines.<sup>115</sup>

Looking back on the framework I constructed in the previous chapter, the interaction between philosophy (of mind) and neuroscience can be said to exhibit signs of significant interdisciplinary interaction. The determination of the type of interdisciplinarity exhibited in this interaction, and its relationship to CIPI, falls beyond the scope of this thesis, but it is clear that significant exchange between the disciplines was taking place. I believe that this climate of exchange and interaction between these two disciplines was something that contributed to the possibility of the creation of mirror neuron empathy. As I will show, input from and collaboration with philosophers and philosophical theory is what drove Gallese to justify according an increasingly important role to mirror neurons in the concept of empathy.

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<sup>112</sup> Patricia Churchland, *Neurophilosophy: Toward a Unified Science of the Mind Brain* (Cambridge: The MIT Press, 1986), 2-5.

<sup>113</sup> Amy Kind, *Philosophy of Mind: The Basics*, 60-62.

<sup>114</sup> Alvin Goldman, *Philosophical Applications of Cognitive Science*, xi-xii.

<sup>115</sup> Alvin Goldman, *Simulating Minds*, 4.



*From action understanding to mind-reading: 'Mirror Neurons and the Simulation Theory of Mind-Reading'*

Armed with knowledge of the philosophical debate between ST and TT, and the knowledge that philosophical debates on the nature of the mind, were heavily influenced by neuroscientific developments, I can move on to an analysis of Gallese's and Goldman's 1998 article *Mirror neurons and the simulation theory of mind reading*. In the following section, I will illuminate some telling aspects of the article and show how this publication can be seen as the very beginning of the connection between mirror neurons and empathy.

In this collaboration, Goldman and Gallese enter the mostly philosophical ST versus TT debate equipped with neuroscientific evidence in the form of mirror neurons. If simulation theory holds true, one should expect to find some neural mechanisms that would enable such simulation. Mirror neurons, Gallese claims, provide us with just this. If we really understand others by means of mental simulation, we need our simulated states to be similar enough to the states observed in others.<sup>116</sup> The functioning of mirror neurons provides them with a mechanism that fulfills this condition. The same pattern is activated both when performing and observing an action, which makes it plausible that the simulated state appropriately resembles the observed one. By mentally mimicking a target, we come to understand their state of mind.<sup>117</sup>

This might, at first sight, sound a lot like a reiteration of the action understanding hypothesis. The key difference, however, can be found in the article's opening lines: "How do we understand other people's behavior? How can we assign goals, intentions, or beliefs to the inhabitants of our social world?"<sup>118</sup> As opposed to the action understanding theory, where action understanding happens on an unconscious level, having little to do with a conscious understanding of people, the claim here is that mirror neuron mechanisms might underly ascription of intention on a more conscious level. This sort of mind-reading, as described in the TT vs. ST section, is often seen as a uniquely human capability, so how do they justify this leap from macaque action understanding to human mind-reading? The answer to this question is their application of an evolutionary framework in which the 'simulation routine' enabled by mirror neurons in the macaque brain could be seen as a prelude to human being's form of mind-reading.<sup>119</sup> In their view, the action-understanding function of mirror neurons offers a stepping

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<sup>116</sup> Vittorio Gallese and Alvin Goldman, "Mirror Neurons and the Simulation Theory of Mind-Reading," 497.

<sup>117</sup> Vittorio Gallese and Alvin Goldman, "Mirror Neurons and the Simulation Theory of Mind-Reading," 497-498.

<sup>118</sup> Vittorio Gallese and Alvin Goldman, "Mirror Neurons and the Simulation Theory of Mind-Reading," 493.

<sup>119</sup> Vittorio Gallese and Alvin Goldman, "Mirror Neurons and the Simulation Theory of Mind-Reading," 493;500.



stone to connecting mirror neurons to human mind-reading abilities. The authors seem to be careful not to attribute all human mind-reading capabilities to mirror neurons, but it is clear that they nevertheless expect mirror neurons to play an important role.<sup>120</sup>

This mix of philosophical and neuroscientific argumentation is something that will continue to characterize Gallese's work. It is also a good illustration of the types of arguments that arose from the (yet unspecified) disciplinary interactions taking place between neuroscience and philosophy around this time. The TT-ST domain specifically, is one that is still characterized by such interaction.<sup>121</sup> Furthermore, this publication clearly shows how philosophical insights played an important role in the first step toward mirror neuron empathy. Not only is it a joint publication between a philosopher and neuroscientist, but both theoretical points of view are given significant attention within the argumentation.

But why care about mirror neurons being mobilized within the mind-reading debate? What does this have to do with a theory of empathy? To answer this question I have to point out that what is understood as 'mind-reading' coincides with a form of empathy, namely 'cognitive empathy'.<sup>122</sup> In connecting mirror neurons to mind-reading through interaction with the philosophical TT versus ST debate, mirror neurons enter the realm of one specific form of empathy for the first time. Nowhere in the article do the authors mention 'empathy' proper, but in my view it is through his involvement in this debate that Gallese got on track to make this connection explicitly in his follow-up articles. As I will show, Gallese will continue to use similar argumentation and apply it to a broader concept of empathy in his further work. Furthermore, another indication of this theory is that Goldman himself connects the notions of mind-reading and empathy in his own work. In *simulating minds*, for example, he defines mindreading as "an extended form of empathy where this term's emotive and caring connotation is bracketed".<sup>123</sup> Therefore I consider this article to be the marker of a second important development in the theories of mirror neuron function. Where we started with mirror neurons as the basis of action recognition, Gallese and Goldman built upon this interpretation and introduced the idea of mirror neurons as the basis of mind-reading or cognitive empathy.

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<sup>120</sup> Vittorio Gallese and Alvin Goldman, "Mirror Neurons and the Simulation Theory of Mind-Reading," 498; 500.

<sup>121</sup> Remy Debes, "Empathy and mirror neurons," 53-63.

<sup>122</sup> Shannon Spaulding, "Cognitive Empathy," in *The Routledge Handbook of Philosophy of Empathy* Ed. Heidi Maibom. 1st ed. (New York : Routledge, 2017), 13.

<sup>123</sup> Alvin Goldman, *Simulating Minds*, 4.

From this point, we can now move on to take a look at the next important publication, in which this connection reaches its mature form.

### **A second encounter with philosophy: from mind-reading to a mirror neuron theory of empathy**

Where Gallese's 1998 collaboration with Goldman only implicitly touches on cognitive empathy, this changes with Gallese's 2001 article *The Shared Manifold Hypothesis: From Mirror Neurons to Empathy*. This time the philosophical influence guiding Gallese's philosophizing comes from phenomenological approaches to empathy, which lead him to formulate what I term a new 'mirror neuron theory of empathy'. This new concept of empathy does not restrict itself to cognitive empathy but instead grounds any form of empathy in the neuroscience of mirror neuron theory. I will proceed by first providing the reader with an overview of the structure and some of the content of the article and subsequently discuss what I call Gallese's 'mirror neuron theory of empathy'. I believe that this new 'mirror neuron theory of empathy' is pivotal in understanding the mirror neuron-empathy boom.

#### *A general overview of 'The Shared Manifold Hypothesis' by Gallese*

From the very beginning of the article, Gallese makes it clear that *The Shared Manifold Hypothesis* should be seen as a continuation and broadening of his work with Goldman. The TT versus ST debate is his starting point, and he explicitly references the 1998 article in a footnote to situate his approach as a form of simulation theory.<sup>124</sup> The aim of this article, however, is more ambitious: Gallese wants to propose a new 'enlarged' notion of empathy in this new publication. The key to this, he says, will be the linking of the concept of empathy and the possibility of intersubjective interaction to agency and action.<sup>125</sup> To clarify what he means by this proposal he starts off with a detailed neuroscientific account of action perception and representation. Different brain regions and types of neural activity are linked to each of these mental categories and relevant connections are explained.<sup>126</sup> The details of this discussion would take me too far outside the scope of my thesis, but the connections he makes between agency or actions and mirror neurons is one I will have to attempt a brief explanation of to make his argument intelligible.

Gallese's argument for his proposed function of mirror neurons roughly follows the conceptual evolution I have tried to sketch out in this chapter, although his article is not

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<sup>124</sup> Vittorio Gallese, "The 'Shared Manifold' Hypothesis: From Mirror Neurons To Empathy," *Journal of Consciousness Studies* 8, No.5-7. (2001): 33-34.

<sup>125</sup> Vittorio Gallese, "The 'Shared Manifold' Hypothesis," 34.

<sup>126</sup> Vittorio Gallese, "The 'Shared Manifold' Hypothesis," 34-39.

structured exactly like my explanation. Gallese starts off by describing how mirror neurons could explain a form of action understanding, as explained in the first section of this chapter, and again, the connection between mirror neurons and mind-reading is offered up.<sup>127</sup> However, a new development here is a much more fundamental argument, namely one formulating the conditions of possibility for any interpersonal interaction whatsoever, not just mind-reading.<sup>128</sup> In other words, Gallese's guiding question has become something akin to 'we know that interpersonal interaction is possible and that there is a way of linking individuals within a social relationship where mutual understanding pervades, but what are the fundamental preconditions that make such a link possible?'

As one would expect, the answer has something to do with mirror neurons. It turns out that mirror neurons could do much more than make us understand the actions and minds of others through the triggering of our 'action vocabulary' during action observation. Without mirror neurons, Gallese claims, we would not be able to have any interpersonal interactions at all.<sup>129</sup> How is such a jump possible? For Gallese, the fundamental reason we recognize other people as actual persons, and not as objects, is the fact that we all possess a similar form of agency. It is because we perform the same actions as other people that we cannot just understand what they are doing, but that we can ascribe personhood to them in the first place.<sup>130</sup> If this shared agency is a precondition for intersubjective interaction, and mirror neurons are an essential component of our action vocabulary, this then makes mirror neurons the basis for such intersubjectivity. As I will discuss soon, it is very clear that Gallese was inspired by phenomenological theories of empathy.<sup>131</sup>

Although Gallese illustrates this basic precondition of human intersubjectivity through the example of our capacity for mind-reading through mirror neurons, he does not restrict human intersubjectivity to cognitive empathy. As I will explain more fully in the next subsection, Gallese believes that a similar mechanism might also underlie our emotional and sensory connections to others.<sup>132</sup> So not only might I have an idea of what you are thinking intellectually at a given moment by observing your actions, but I might also come to understand how you are feeling emotionally and feel physically. Think back to the 'stepping on a nail' example I gave earlier. When I see someone step on a nail I know that they must be thinking

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<sup>127</sup> Vittorio Gallese, "The 'Shared Manifold' Hypothesis," 35-37.

<sup>128</sup> Vittorio Gallese, "The 'Shared Manifold' Hypothesis," 41-42.

<sup>129</sup> Vittorio Gallese, "The 'Shared Manifold' Hypothesis," 41-42.

<sup>130</sup> Vittorio Gallese, "The 'Shared Manifold' Hypothesis," 44-45.

<sup>131</sup> Vittorio Gallese, "The 'Shared Manifold' Hypothesis," 41; 43.

<sup>132</sup> Vittorio Gallese, "The 'Shared Manifold' Hypothesis," 45.

that it hurts, I can almost feel their pain, their anger, or annoyance and similarly have an urge to move my foot away from the offending nail. To Gallese, the collection of all these different ways we understand and interact with others is what he calls empathy. Empathy is then the fundamental link that makes people understand people as persons on several different levels and is the basic precondition for any intersubjective bond or interaction, but more on this in the next section.<sup>133</sup> Another way of looking at what Gallese accomplishes here is to say that Gallese unifies different types of empathy and elements of intersubjective experiences into one concept, namely empathy. Gallese speculates that all these aspects must at least in part be underlain by a mirror mechanism.

### *Gallese and Phenomenological Empathy*

How did Gallese further justify his idea to extend his theory of mind-reading to such an encompassing theory of empathy? Luckily for me, he answers this question himself. To understand what Gallese means by empathy he provides the reader with a short clarification of the term. The brand of empathy Gallese is referring to here is ‘empathy’ as a phenomenological term. Similarly to my explanation, Gallese starts by situating the origin of the term in German Aesthetics at the beginning of the 20th century, but after a very short introduction using Lipps, he quickly moves onto the philosophical phenomenologist’s account of empathy.<sup>134</sup> As I already mentioned in the first chapter, Husserl and Stein are important figures here, but Gallese adds Merleau-Ponty to this list as well. What all these phenomenologists share is a fundamental link between embodiment, action, and intersubjectivity. We recognize people as agents and persons, not because we look similar, but because we are embodied similarly, leading to a similar way of acting in the world. For phenomenologists, empathy is a fundamental component of our social interactions, namely that which makes us perceive others as similar to us.<sup>135</sup> This link between empathy and agency is exactly Gallese’s explanation of the term, which I explained in the paragraph above.

It might be interesting to note that Gallese was not the only neuroscientist influenced by phenomenology at the time. Neuro-phenomenology was an already existing field of research that emerged roughly at the time of the early development of mirror neuron theory, namely the 1990s. The handbook *Neurophenomenology and its Applications to Psychology* defines the field as “a scientific endeavor that combines neuroscience and phenomenology to study experience

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<sup>133</sup> Vittorio Gallese, “The ‘Shared Manifold’ Hypothesis,” 42.

<sup>134</sup> Vittorio Gallese, “The ‘Shared Manifold’ Hypothesis,” 43.

<sup>135</sup> Vittorio Gallese, “The ‘Shared Manifold’ Hypothesis,” 43-44.

from the perspective of the embodied condition of the human mind.”<sup>136</sup> Gallese himself was clearly influenced by this field, as evidenced by the fact that he cites Antonio Damasio as one of the sources who inspired his jump from mirror neurons underlying mind-reading to encompassing forms of affective empathy.<sup>137</sup> Damasio, a Portuguese neuroscientist is oftentimes associated with this movement, showing that a connection between Gallese and neurophenomenology can be found.<sup>138</sup> It would take me too far beyond the scope of my thesis to give an in-depth overview of this field, but it is important to note that neuroscience was not only interacting with philosophy of mind at the end of the 20<sup>th</sup> century but was also involved in interactions with phenomenology. I believe that Gallese’s construction of his mirror neuron theory of empathy is a manifestation of such an interaction.

*The Shared manifold hypothesis: A first theory of mirror neuron empathy*

To further elaborate on his new concept of empathy, Gallese introduces what he calls a new conceptual tool’, namely ‘the shared manifold of intersubjectivity’. This manifold consists of three levels, each of which all individuals share. It is through these shared elements that ‘we recognize others as similar to us’.<sup>139</sup> The following is a verbatim explanation of how this ‘shared manifold’ operates according to Gallese:

“The shared manifold can be operationalized at three different levels: A phenomenological level; a functional level; and a subpersonal level.

1. The *phenomenological level* is the one responsible for the sense of similarity, of being individuals within a larger social community of persons like us, that we experience anytime we confront ourselves with other human beings. It could be defined also as the *empathic level*, provided that empathy is characterized in the ‘enlarged’ way I was advocating before. Actions, emotions and sensations experienced by others become meaningful to us because we can *share* them with them.

2. The *functional level* can be characterized in terms of simulation routines, *as if* processes enabling models of others to be created.

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<sup>136</sup> Stanley Krippner, “Foreword,” in *Neurophenomenology and Its Applications to Psychology* Susan Gordon ed. (New York, NY: Springer, 2013), xii, <https://doi.org/10.1007/978-1-4614-7239-1>.

<sup>137</sup> Vittorio Gallese, “The Shared Manifold Hypothesis,” 37, 46

<sup>138</sup> Evan Thompson et al., “Neurophenomenology: An Introduction for Neurophilosophers,” in *Cognition and the Brain : The Philosophy and Neuroscience Movement* Andrew Brook and Kathleen eds. (Cambridge University Press, 2005), 40-97.

<sup>139</sup> Vittorio Gallese, “The ‘Shared Manifold’ Hypothesis,” 44-45.

3. The *subpersonal level* is instantiated as the result of the activity of a series of mirror matching neural circuits. A dual mode of operation, an *expressive* mode and a *receptive* mode characterizes these circuits. The activity of these neural circuits is, in turn, tightly coupled with multi-level changes within body-states”<sup>140</sup>

As the reader might agree, this description fails to establish a clear idea of how exactly the different levels relate to each other. Unfortunately, later publications by Gallese feature an almost exact copy of the quote above, which forces me to interpret its meaning myself. As I understand it, the different levels of the manifold represent different aspects of one and the same theory of empathy. Different levels are causally related, with the bottom level being the most basic and reduced one, moving up in abstraction to the phenomenological level. The first level is the lived experience of emotions, sensations, and mind-reading. The way in which we, in our everyday experience, feel similar to other people. These experiences are then all made possible through the same basic abstract mechanism of simulation, the subconsciously ‘putting ourselves in someone else’s shoes’. These processes are then, on a physical level, constituted by our neural architecture containing mirror neurons and mirror matching mechanisms that underlay the second and first levels. If my interpretation is correct, this would essentially make Gallese’s manifold hypothesis a naturalized, explanatory reductive theory of a very broad concept of empathy, encompassing all types of shared experiences between individuals. In essence, Gallese’s theory of empathy could be said to be a unified theory of empathy, as all the phenomena are unified by explanation through mirror neuron mechanisms. Empathetic links, constituted by the different levels of the manifold that all of us have, are then at the very basis of every social interaction. It seems to me that through the construction of these different levels, Gallese attempts to link neuroscientific, philosophy of mind, and phenomenological theories of empathy into one integrated unit.

An attentive reader might remark that this description sounds a lot like what I described as a CIPI-type of interdisciplinarity. Could this then mean that the emergence of mirror neuron empathy within social neuroscience could rightly be described as a CIPI-style interaction between philosophy and neuroscience? Although this type of interaction might have characterized the formation of the first theory of mirror neuron empathy, it is not representative of Gallese’s successors, who were important in continuing mirror neuron empathy research within social neuroscience. It is to these successors I turn now, before further addressing this

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<sup>140</sup> Vittorio Gallese, “The ‘Shared Manifold’ Hypothesis,” 45.

question. For now, it is enough to note that the construction of Gallese's manifold hypothesis is not representative of the way his successors carried on the connection between mirror neurons and empathy.

### **The continuation of mirror neuron empathy in social neuroscience**

After his initial publication in 2001, Gallese published several follow-up papers about his shared manifold hypothesis of empathy.<sup>141</sup> Additionally, Rizzolatti, the head researcher of the Parma team, later published academic papers and a popular book on the connection between mirror neurons and empathy.<sup>142</sup> However, the influence of Gallese's proposal of a relationship between mirror neurons and empathy was not restricted to just the Parma group. As we have seen in the previous chapter, mirror neuron empathy research is considered an important first research program within social neuroscience, and this is precisely because the Parma team influenced several other researchers to join their efforts. An important figure here is Marco Iacoboni, an Italian neuroscientist who is the director of the Ahmanson-Lovelace Brain Mapping Center at UCLA.<sup>143</sup> Coincidentally, Marco Iacoboni was also one of the people involved in organizing the first social neuroscience conference at UCLA in 2001.<sup>144</sup> In his biography, Rizzolatti states that he had started collaborating on mirror neuron research with Iacoboni in his fMRI lab in 1999.<sup>145</sup> It is therefore fair to assume that significant exchanges would have occurred between the Parma team and Iacoboni. This is further confirmed by an important 2003 article, which is to my knowledge one of the first neuroscientific papers which takes up Gallese's proposal for mirror neuron empathy within empirical social neuroscience.<sup>146</sup> In this paper, Iacoboni and his colleagues cite Gallese's *Shared Manifold* paper and very briefly

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<sup>141</sup> Vittorio Gallese, "The Manifold Nature of Interpersonal Relations: The Quest for a Common Mechanism," *Philosophical Transactions of the Royal Society of London, Series B: Biological Sciences* 358, no. 1431 (March 29, 2003): 517–28. <https://doi.org/10.1098/rstb.2002.1234>.

Vittorio Gallese, "Embodied Simulation: From Neurons to Phenomenal Experience," *Phenomenology and the Cognitive Sciences* 4, no. 1 (March 2005): 23–48. <https://doi.org/10.1007/s11097-005-4737-z>;

<sup>142</sup> Giacomo Rizzolatti and Laila Craighero, "Mirror neuron: a neurological approach to empathy," In *Neurobiology of Human Values. Research and Perspectives in Neurosciences* Changeux, JP., Damasio, A.R., Singer, W., Christen, Y. eds. (Berlin, Heidelberg: Springer, 2005), 107-123, [https://doi.org/10.1007/3-540-29803-7\\_9](https://doi.org/10.1007/3-540-29803-7_9); Giacomo Rizzolatti and Corrado Sinigaglia, *Mirrors in the Brain. How Our Minds Share Actions, Emotions, and Experience*, translated by Frances Anderson. (Oxford: Oxford University press, 2008)

<sup>143</sup> UCLA Brain Mapping Center, "People: Marco Iacoboni, M.D.Ph.D.," visited on July 21st 2023 [http://www.bmap.ucla.edu/about/people/details/marco\\_iacoboni/](http://www.bmap.ucla.edu/about/people/details/marco_iacoboni/)

<sup>144</sup> Matthew D. Lieberman, "A Geographical History of Social Cognitive Neuroscience," *NeuroImage* 61, no. 2 (June 2012): 434.

<sup>145</sup> Giacomo Rizzolatti, "Giacomo Rizzolatti," in *The History of Neuroscience in Autobiography* Volume 9, eds. Thomas D. Albright and Larry R. Squire. (Washington DC: Society for Neuroscience, 2016), 336.

<sup>146</sup> Laurie Carr, Marco Iacoboni, Marie-Charlotte Dubeau, John C. Mazziotta, and Gian Luigi Lenzi. "Neural Mechanisms of Empathy in Humans: A Relay from Neural Systems for Imitation to Limbic Areas," *Proceedings of the National Academy of Sciences* 100, no. 9 (April 29, 2003): 5497–5502.

describe a similar view of empathy by referring to Lipp's *Einfühlung*.<sup>147</sup> They further describe a mechanism for empathy that closely resembles Gallese's description, namely a mental imitation mechanism based in the motor system, which corresponds to a simulationist explanation of empathy.<sup>148</sup> Iacoboni and his colleagues took Gallese's proposal for a common mechanism of cognitive and affective empathy seriously. This article went on to be cited more than 3,000 times to this date, which clearly demonstrates its influence.<sup>149</sup> In the years to come, Iacoboni would continue to put out publications linking mirror neurons to empathy, among which a collaboration with Gallese.<sup>150</sup> Additionally, Iacoboni also published his own popular science book on mirror neurons and empathy, further cementing the topic as an important issue for cognitive neuroscience in public consciousness.<sup>151</sup> Moreover, many interviews and public appearances can be found in which he promotes the importance of mirror neurons and their link to empathy.<sup>152</sup> To this day Iacoboni is one of the most prominent faces of mirror neuron research. It is therefore fair to say that through Iacoboni, Gallese's proposal was carried along and further entrenched within social neuroscientific research.

A second important figure in mirror neuron empathy research that can be directly connected to the Parma team is Christian Keysers. Keysers is a prominent social neuroscientist who is affiliated with the Netherlands Institute for Neuroscience and has his own laboratory and research group. The website for the institute describes the research conducted there as follows: "Christian Keysers' lab focuses on providing increasingly detailed insights into how exactly the brain achieves this remarkable feat of empathy."<sup>153</sup> Just like Iacoboni, Keysers also has a history connecting him to the Parma group. Rizzolatti mentions meeting him as an

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<sup>147</sup> Laurie Carr, Marco Iacoboni, Marie-Charlotte Dubeau, John C. Mazziotta, and Gian Luigi Lenzi, "Neural Mechanisms of Empathy in Humans," 5497.

<sup>148</sup> *Ibid.*, 5497; 5502.

<sup>149</sup> PubMed, National Library of Medicine: National Center for Biotechnology Information.

<https://pubmed.ncbi.nlm.nih.gov/12682281/>

<sup>150</sup> Marco Iacoboni and Mirella Dapretto, "The Mirror Neuron System and the Consequences of Its Dysfunction," *Nature Reviews Neuroscience* 7, no. 12 (December 1, 2006): 942–51.

<https://doi.org/10.1038/nrn2024>; Marco Iacoboni, Istvan Molnar-Szakacs, Vittorio Gallese, Giovanni Buccino, John C Mazziotta, and Giacomo Rizzolatti, "Grasping the Intentions of Others with One's Own Mirror Neuron System," *PLoS Biology* 3, no. 3 (February 22, 2005): e79. <https://doi.org/10.1371/journal.pbio.0030079>; Jonas T. Kaplan and Marco Iacoboni, "Getting a Grip on Other Minds: Mirror Neurons, Intention Understanding, and Cognitive Empathy," *Social Neuroscience* 1, no. 3–4 (September 2006): 175–83.

<https://doi.org/10.1080/17470910600985605>.

<sup>151</sup> Marco Iacoboni, *Mirroring People: The Science of Empathy and How We Connect with Others* (New York: Picador, Farrar, Straus and Giroux, 2009)

<sup>152</sup> examples of this include: Anita Nowak. "Mirror Neurons: The Science Behind Empathy Ft. Dr. Marco Iacoboni Purposeful Empathy," December 2, 2022. <https://www.youtube.com/watch?v=Qo9BboyYtt4>; Edwin Rutsch. "Marco Iacoboni & Edwin Rutsch: How to Build a Culture of Empathy with Mirror Neurons," January 27, 2012. <https://www.youtube.com/watch?v=cuLCRPJZPkA>.

<sup>153</sup> Netherlands Institute for Neuroscience - Master the Mind. "Keysers - Netherlands Institute for Neuroscience - Master the Mind," December 19, 2022. <https://nin.nl/research-groups/keysers/>.



enthusiastic postdoc at the Parma lab, where he later collaborated with both Rizzolatti himself and Gallese.<sup>154</sup> Keysers was first involved in research investigating the functional properties of mirror neurons, but later continued to work on linking mirror neurons to social phenomena like empathy.<sup>155</sup> In 2003 Keysers worked together with Gallese, Rizzolatti, and other researchers to provide an empirical basis for Gallese's expansion of mirror neuron function to affective empathy.<sup>156</sup> Another important publication that ensued from this collaboration is the 2004 article *A Unifying View of the Basis of Social Cognition*, where the authors more or less confirm what Gallese proposed as a unifying theory of empathy in his shared manifold paper.<sup>157</sup> Mirror neurons are again proposed to lay the basis for both affective and cognitive empathy. Throughout the years Keysers would continue to publish papers surrounding this mirror neuron theory of empathy and social cognition.<sup>158</sup> Just like Iacoboni, Gallese, and Rizzolatti, Keysers has also published a popular science book detailing the connection between empathy and mirror neurons and remains an important figure within the field.<sup>159</sup> Again, Keyser's work is proof of the continuing influence of Gallese's initial connection between empathy and mirror neurons, as Keysers essentially adhered to Gallese's unifying mechanism. The collaborative 2004 article has been cited more than 3400 times, and multiple of his papers on mirror neuron empathy have been cited thousands of times.<sup>160</sup>

What Keysers and Iacoboni demonstrate is that although Gallese's mirror neuron empathy started off as a theoretical proposal relying vastly on philosophical argumentation, it was later taken up by more empirically minded social neuroscientists. Through Gallese's unifying theory of empathy, this next generation of mirror neuron researchers could further investigate mirror neuron involvement in their enlarged form of empathy by mirror neurons as

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<sup>154</sup> Giacomo Rizzolatti, "Giacomo Rizzolatti," 369.

<sup>155</sup> Christian Keysers, E. Kohler, M. A. Umiltà, L. Nanetti, L. Fogassi, and V. Gallese, "Audiovisual Mirror Neurons and Action Recognition," *Experimental Brain Research* 153, no. 4 (December 1, 2003): 628–36.

<https://doi.org/10.1007/s00221-003-1603-5>; Valeria Gazzola, Lisa Aziz-Zadeh, and Christian Keysers.

"Empathy and the Somatotopic Auditory Mirror System in Humans," *Current Biology* 16, no. 18 (September 2006): 1824–29. <https://doi.org/10.1016/j.cub.2006.07.072>.

<sup>156</sup> Bruno Wicker, Christian Keysers, Jane Plailly, Jean-Pierre Royet, Vittorio Gallese, and Giacomo Rizzolatti. "Both of Us Disgusted in My Insula: The Common Neural Basis of Seeing and Feeling Disgust," *Neuron*, Vol. 40, No.3 (2003) 655–664, doi: 10.1016/s0896-6273(03)00679-2.

<sup>157</sup> Vittorio Gallese, C Keysers, and G Rizzolatti, "A Unifying View of the Basis of Social Cognition," *Trends in Cognitive Sciences* 8, no. 9 (September 2004): 396–403. <https://doi.org/10.1016/j.tics.2004.07.002>.

<sup>158</sup> Christian Keysers, and Valeria Gazzola, "Towards a Unifying Neural Theory of Social Cognition," *Progress in Brain Research*, 156 (2006):379–401. [https://doi.org/10.1016/S0079-6123\(06\)56021-2](https://doi.org/10.1016/S0079-6123(06)56021-2).

<sup>159</sup> Christian Keysers, *Empathic Brain: How the Discovery of Mirror Neurons Changes Our Understanding of Human Nature*. (Social Brain Press, 2011)

<sup>160</sup> PubMed. National Library of Medicine: National Center for Biotechnology Information; <https://pubmed.ncbi.nlm.nih.gov/14642287/>; Google Scholar. "Author profile: Christian Keysers," <https://scholar.google.com/citations?user=yogBzjEAAA&hl=en>.

a basis for any kind of empathy. There were however some differences between their research and Gallese's mirror neuron empathy. Keysers and Iacoboni published articles that conformed more to the format of traditional neuroscientific publications, meaning that neither of them dwelt on the definition and tradition of empathy research with the same amount of care as Gallese did in his more theoretically oriented publications. Furthermore, most of these articles use traditional neuroscientific methods such as fMRI and transcranial magnetic stimulation (TMS), while also directing almost all their attention at the neuroscientific level of analysis.<sup>161</sup> These characteristics are something I will come back to in the next section. A detailed study of how mirror neuron empathy was further developed lies beyond the scope of this thesis, but I want to illustrate that Gallese's mirror neuron empathy took on features of more traditional neuroscientific research through researchers like Keysers and Iacoboni, who further incorporated the idea of mirror neuron empathy within the social neuroscience literature.

### **mirror neuron empathy described through CIPI?**

Now that I have presented the historical development of mirror neuron empathy and how it actually took place, I can compare this history with the theoretical expectations I described in the last chapter. In doing this I will show that mirror neuron empathy cannot be described as stemming from a CIPI interaction between social psychology and neuroscience, as would be expected from the self-conceptualization of its parent discipline, social neuroscience. In fact, I will argue that we cannot properly describe the emergence of mirror neuron empathy as a CIPI-style interaction at all. I will conclude that a different vocabulary for interdisciplinarity is needed to describe what happened in the development of mirror neuron empathy.

### *What Interdisciplinary interaction?*

The first and most obvious difference between the representation set out by the self-concept of social neuroscience and the actual historical development of mirror neuron empathy is the lack of interaction between the fields of social psychology and neuroscience. In my description of the development of Gallese's theory of mirror neuron empathy, I don't mention a single instance of interaction between these two fields. Instead, it is very clear that the disciplines involved in

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<sup>161</sup> Examples of these papers, all of which were already mentioned include: Bruno Wicker, Christian Keysers, Jane Plailly, Jean-Pierre Royet, Vittorio Gallese, and Giacomo Rizzolatti, "Both of Us Disgusted in My Insula: The Common Neural Basis of Seeing and Feeling Disgust," 655-664; Christian Keysers, and Valeria Gazzola, "Towards a Unifying Neural Theory of Social Cognition," 379-401; Vittorio Gallese, C Keysers, and G Rizzolatti, "A Unifying View of the Basis of Social Cognition," 396-403; Marco Iacoboni, and Mirella Dapretto. "The Mirror Neuron System and the Consequences of Its Dysfunction," 942-51; Jonas T. Kaplan, and Marco Iacoboni, "Getting a Grip on Other Minds: Mirror Neurons, Intention Understanding, and Cognitive Empathy," 175-83. <https://doi.org/10.1080/17470910600985605>.

the creation of this theory were neuroscience and philosophy. During my research, I could not find a single citation of a social psychological paper in the articles leading up to the *Shared Manifold Hypothesis*. This is further evidenced by the complete lack of reference to social psychological theory within Gallese's articles and a lack of acknowledgment of the existence of such theories of empathy. Nevertheless, through his formulation of the first mirror neuron theory of empathy, Gallese still extended neuroscience into the domain of the discipline of social psychology. However, looking at the evidence presented above, this development can hardly be described as a form of CIPI interdisciplinarity with social psychology.

In the continuation of mirror neuron empathy by Iacoboni and Keysers within the papers cited in the previous section, it is hard to detect an interaction with any discipline outside of neuroscience at all. Firstly, the influence of philosophy in creating the connection between mirror neurons and empathy is not readily acknowledged. Although both Keysers and Iacoboni cite Gallese in their work on mirror neuron empathy and were demonstrably influenced by his and the Parma team's work, neither of them pays special attention to the philosophical aspect of his theory. In defining the concept of empathy Iacoboni quickly refers to Lipps and presents an extremely condensed definition of the term: "Empathy plays a fundamental social role, allowing the sharing of experiences, needs, and goals across individuals."<sup>162</sup> This definition is clearly reminiscent of Gallese's concept of mirror neuron empathy, but contrary to Gallese, Iacoboni does not elaborate on the philosophical insights that might be helpful in understanding empathy. Within Keyser's work the term 'empathy' is regularly used and posited as a phenomenon based on mirror neuron activity, but in the articles I reviewed, he refrains from providing a clear definition of the term at all, let alone a philosophical discussion of its meaning.<sup>163</sup> However, as mentioned, Keysers still proposes mirror neurons as the mechanism at the base of mind-reading, action understanding and the sharing of emotions in two later papers, including a collaboration with Gallese.<sup>164</sup> Just like Iacoboni, Keysers seems to have been influenced by Gallese's mirror neuron empathy but abstained from continuing the

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<sup>162</sup> Laurie Carr Marco Iacoboni, Marie-Charlotte Dubeau, John C. Mazziotta, and Gian Luigi Lenzi, "Neural Mechanisms of Empathy in Humans: A Relay from Neural Systems for Imitation to Limbic Areas," 5497.

<sup>163</sup> Gazzola, Aziz-Zadeh, and Keysers, "Empathy and the Somatotopic Auditory Mirror System in Humans," 1824-1829; Keysers and Gazzola, "Towards a Unifying Neural Theory of Social Cognition," 379-401; Wicker et al., "Both of Us Disgusted in My Insula: The Common Neural Basis of Seeing and Feeling Disgust," 655-664.

<sup>164</sup> Vittorio Gallese, C Keysers, and G Rizzolatti, "A Unifying View of the Basis of Social Cognition," *Trends in Cognitive Sciences* 8, no. 9 (September 2004): 396-403. <https://doi.org/10.1016/j.tics.2004.07.002>; Christian Keysers, and Valeria Gazzola, "Towards a Unifying Neural Theory of Social Cognition," *Progress in Brain Research*, 156 (2006): 379-401 [https://doi.org/10.1016/S0079-6123\(06\)56021-2](https://doi.org/10.1016/S0079-6123(06)56021-2).

interdisciplinary interaction with philosophy started by Gallese. Furthermore, Instead of looking like Gallese's neurophilosophical publications, Keyzers and Iacoboni's publications are formulated as typical, empirically oriented neuroscientific studies. Most of their articles are taken up by the analysis and gathering of empirical neuroscientific data. Moreover, the analysis within these papers focuses mostly on the neural level of analysis. Although Iacoboni and Keyzers were influenced by the neurophilosophical theory developed by Gallese they did not sustain the same level of interaction between neuroscience and philosophy within their work. Secondly, no significant attention is paid to social psychological theory or any social scientific theory in general. I could not find proof of Iacoboni or Keyzers being significantly influenced by social psychological theory in the creation of their versions of mirror neuron empathy. I believe that the biggest influence on their view of empathy was Gallese's theory. It is only in a 2009 article, published well after the initial rise of mirror neuron empathy that Iacoboni first published a review that acknowledges and discusses social psychological theories which could be associated with mirror neuron research.<sup>165</sup> This however is too little, too late to credit such an interaction as the source of mirror neuron empathy.

To illustrate this lack of significant interaction with either philosophy or social psychology in the continuation of mirror neuron empathy, I can make use of an example, namely a 2006 article by Iacoboni in which he lends support to the claim that mirror neurons underlie empathy.<sup>166</sup> Within this article, only a very small textbox is dedicated to social scientific theories of the phenomenon. The total amount of words dedicated to all social scientific and philosophical theories of empathy in this text is an unimpressive 269 words, accounting for a meager 2,69% of the total article. None of these theories are explained, and the sole purpose of their mention is to claim that these phenomena can be reduced down to a description of mirror neuron empathy. This mention does furthermore not qualify as any claim to a multilevel theory, as they give no attention to any of the contents of these social theories. It is worth noting that in the conclusion of this article, Iacoboni mentions his mirror neuron research as relevant to social neuroscience, signaling that this article should indeed be seen as an addition to this research field.<sup>167</sup>

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<sup>165</sup> Marco Iacoboni, "Imitation, Empathy, and Mirror Neurons," *Annual Review of Psychology* 60, no. 1 (January 1, 2009): 653–70. <https://doi.org/10.1146/annurev.psych.60.110707.163604>.

<sup>166</sup> Iacoboni and Dapretto, "The Mirror Neuron System and the Consequences of Its Dysfunction," 943.

<sup>167</sup> Iacoboni and Dapretto, "The Mirror Neuron System and the Consequences of Its Dysfunction," 942-951.

### *The unsuitability of the CIPI framework*

As I already mentioned, Given Gallese's mirror neuron empathy, one may question if it can be described as a CIPI interaction between philosophy and neuroscience. This would invalidate social neuroscience's claim of interdisciplinarity with social psychology but would mean that I could still describe the interdisciplinarity at hand using the CIPI framework. Gallese's theory seems to be a multilevel theory that includes insights from both philosophy and neuroscience. The relationship between these levels of analysis can be interpreted as one of explanatory reduction, which enables Gallese to connect his different levels of analysis. Furthermore, Gallese seems to be motivated by a desire for unification/integration as evidenced by his unifying concept of empathy. Actual communication with philosophy is evidenced by his collaboration with Goldman and his integration of phenomenological theory.

Although this interpretation is tempting, I believe that it would fail to represent the full history of early mirror neuron empathy. Even though it might be possible to claim that a CIPI interaction took place in the formation of the very first mirror neuron empathy theory by Gallese, this interaction was not sustained in the long term. Gallese's successors, Iacoboni and Keysers definitely do not display a CIPI-style interaction with the field of philosophy. They do not acknowledge that it was an interdisciplinary interaction at all. As I have illustrated in a previous paragraph, these researchers accord almost no attention to either philosophy or social psychology. Their version of mirror neuron empathy, although it is influenced by Gallese, does not contain the same nuance and attention to different levels of analysis. There is no multilevel theory and no inclusion of or communication with other disciplines. Furthermore, the publications by Keysers and Iacoboni mostly fit the style and methods of classical empiric neuroscientific research. For example, in the same 2006 article I mentioned before, there is a distinct focus on neuroanatomy, citing studies based on neuroimaging techniques such as fMRI and positron emission tomography (PET), which are traditionally neuroscientific tools. This in itself would not be an issue if this neuroscientific style was complimented by relating it to social psychological or even philosophical theory, but as I have already established, this is not the case. In this later incarnation, mirror neuron empathy cannot be described as a CIPI-style interaction at all, neither with social psychology nor with philosophy.

Furthermore, mirror neuron empathy would later be claimed as an important part of social neuroscience, which explicitly portrays itself as a CIPI interaction between social psychology and neuroscience. A representation of the actual relationship between these two

disciplines is therefore of specific interest to me. It is after all, these two disciplines that are held up as the relevant contributors. For this reason, and the one named above, I believe that representing mirror neuron empathy as a CIPI interaction between philosophy and neuroscience could only illuminate a part of the picture. It might well be that this is the type of interaction that occurred with Gallese specifically, but it is not an interaction that is representative of the whole story. This is especially the case when social neuroscience's self-concept is taken seriously, because it indicates that some relationship between social psychology and neuroscience should be established, however performative, as social neuroscientists claimed a relationship between the two disciplines.

It would seem that I am now at a loss for describing the interdisciplinary interaction that gave rise to mirror neuron empathy. I am left with a transitory interaction between neuroscience and philosophy in the creation of the first theory of empathy, and an almost complete lack of interaction between different disciplines in its continuation. However, social neuroscience, as the parent discipline that presents itself as the embodiment of the CIPI still claims mirror neuron empathy as an integral part of its development. In my opinion, this claim to interdisciplinarity with social neuroscience, without 'practicing what they preach', still reveals a certain attitude towards social psychology. I cannot say that the disciplines simply don't interact at all if social neuroscience still adheres to this ideal of interdisciplinarity. Some more nuanced type of veiled (non)-interaction seems to be going on here, one I cannot describe in terms of CIPI.

# Chapter 3 The emergence of mirror neuron empathy described through a practical framework for interdisciplinarity

Now that I have shown that the development of mirror neuron empathy cannot be described in terms of the theoretical CIPI-framework, it is time for me to turn to a more practical approach. In this chapter, I will introduce an alternative view of interdisciplinarity, which is less rigid and therefore more adaptable to empirical observation than CIPI. This framework will provide me with the concept of scientific imperialism. This is a new subtype of interdisciplinary interaction, from which I will borrow a descriptive vocabulary that I will then use to recount the history of mirror neuron empathy as it happened in practice. In doing this I will introduce an addition to this framework, namely the mechanism of disciplinary bridging. After describing my case study in terms of (neuro)scientific imperialism, I will end this chapter by giving some indications as to how this practical imperialism framework might apply to social neuroscience in general.

## Constructing a practical framework for interdisciplinarity and introducing Uskali Mäki's scientific imperialism

### *A new, practical conceptualization of interdisciplinarity*

In recent years a number of philosophers of science have argued to move away from the rigid theoretical conceptualization of interdisciplinarity that is the CIPI. Henrik Thorén and Johannes Persson for example argue for a broader understanding of interdisciplinarity that deviates from the traditional integrative understanding. They also propose alternative forms of interdisciplinarity, finding examples in the field of sustainability science.<sup>168</sup> Similarly, Till Grüne-Yanoff argues for the acknowledgment of interdisciplinary interactions that are successful but that do not necessarily involve disciplinary integration.<sup>169</sup> Moreover, the identification of alternative forms of interdisciplinarity is also an explicit theme in many recent handbooks on the philosophy of interdisciplinarity.<sup>170</sup> For my purposes, the most important

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<sup>168</sup>Henrik Thorén and Johannes Persson, "The Philosophy of Interdisciplinarity: Sustainability Science and Problem-Feeding," *Journal for General Philosophy of Science* 44, no. 2 (December 2013): 337–55. <https://doi.org/10.1007/s10838-013-9233-5>.

<sup>169</sup>Till Grüne-Yanoff, "Interdisciplinary Success without Integration," *European Journal for Philosophy of Science* 6, no. 3 (October 2016): 343–60. <https://doi.org/10.1007/s13194-016-0139-z>.

<sup>170</sup>Examples: Jan Cornelius Schmidt, "Introduction: What does the philosophy of interdisciplinarity offer?," in *Philosophy of Interdisciplinarity: Studies in Science, Society and Sustainability* 1st ed. (London: Routledge, 2021), 1-15 <https://doi.org/10.4324/9781315387109>; Robert Frodeman, "The Future of Interdisciplinarity: An



figure in this movement to redefine interdisciplinarity is the Finnish philosopher of science Uskali Mäki. It is his altered, practically oriented framework for interdisciplinarity that I will present in the following section.

In multiple of his publications Mäki advocates for increased attention to the philosophy of interdisciplinarity from the philosophy of science.<sup>171</sup> Mäki claims that it is important for philosophy of science to develop a strong framework for interdisciplinarity, given the increasing prevalence of interdisciplinary science. However, the existing theoretical framework does not satisfy this need. If we want to keep up with scientific practice, our toolkit for describing interdisciplinarity needs an update.<sup>172</sup> As Mäki puts it: “Talk about interdisciplinarity is different from interdisciplinarity present in scientific practice.”<sup>173</sup> This ‘talk’ which Mäki refers to, is what I have described as CIPI in chapter 3, namely a theoretical conceptualization of interdisciplinarity where disciplinary unification and integration are seen as the golden standard of interdisciplinary interaction. Mäki renounces this view of interdisciplinarity as “intensionally rather thick, and extensionally narrow”<sup>174</sup>, meaning that its definition is too precise to cover everything that is termed ‘interdisciplinarity’ in practice. According to Mäki, philosophers of science can address this discrepancy between theory and practice by focusing on descriptive accounts of real interdisciplinarity.<sup>175</sup> These real-life cases might then help us develop a philosophy of interdisciplinarity more suited to actual practice.<sup>176</sup> Coincidentally, this is precisely the approach that seems necessary for my case study, which also cannot be analyzed using the theoretical CIPI framework.

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Introduction to the 2nd Edition,” In *The Oxford Handbook of Interdisciplinarity*, edited by Robert Frodeman, 2nd ed., 3–8 (Oxford University Press, 2017) <https://doi.org/10.1093/oxfordhb/9780198733522.013.1>.

<sup>171</sup> Uskali Mäki, “Philosophy of Interdisciplinarity. What? Why? How?,” *European Journal for Philosophy of Science* 6, no. 3 (October 2016): 327–42. <https://doi.org/10.1007/s13194-016-0162-0>; ; Uskali Mäki, and Miles MacLeod, “Interdisciplinarity in Action: Philosophy of Science Perspectives,” *European Journal for Philosophy of Science* 6, no. 3 (October 2016): 323–26. <https://doi.org/10.1007/s13194-016-0161-1>.

<sup>172</sup> Uskali Mäki, “Philosophy of Interdisciplinarity. What? Why? How?,” 328–331; Miles MacLeod, Martina Merz, Uskali Mäki and Michiru Nagatsu, “Investigating Interdisciplinary Practice: Methodological Challenges (Introduction),” *Perspectives on Science* 27, no. 4 (August 2019): 545 [https://doi.org/10.1162/posc\\_e\\_00315](https://doi.org/10.1162/posc_e_00315); Uskali Mäki, and Miles MacLeod, “Interdisciplinarity in Action: Philosophy of Science Perspectives,” *European Journal for Philosophy of Science* 6, no. 3 (October 2016): 323–26. <https://doi.org/10.1007/s13194-016-0161-1>.

<sup>173</sup> Uskali Mäki, “Philosophy of Interdisciplinarity. What? Why? How?,” 330.

<sup>174</sup> Uskali Mäki, “Philosophy of Interdisciplinarity. What? Why? How?,” 331.

<sup>175</sup> Miles MacLeod, Martina Merz, Uskali Mäki, and Michiru Nagatsu, “Investigating Interdisciplinary Practice: Methodological Challenges (Introduction),” *Perspectives on Science* 27, no. 4 (August 2019): 546 [https://doi.org/10.1162/posc\\_e\\_00315](https://doi.org/10.1162/posc_e_00315).

<sup>176</sup> Uskali Mäki, “Philosophy of Interdisciplinarity. What? Why? How?,” 331–332; Uskali Mäki, and Miles MacLeod, “Interdisciplinarity in Action: Philosophy of Science Perspectives,” *European Journal for Philosophy of Science* 6, no. 3 (October 2016): 323–26. <https://doi.org/10.1007/s13194-016-0161-1>.



How then does Mäki view interdisciplinarity, if he rejects the CIPI? To account for the diversity of interdisciplinary interactions within scientific practice, Mäki adheres to an extremely broad definition of ‘interdisciplinarity’:

“My preference is for an intensionally much thinner and thereby extensionally broader concept of interdisciplinarity that I suggest putting simply in terms of *whatever relevant relationship between two or more scientific disciplines or their parts*. This keeps silent about the ambitions driving it (e.g. seeking to solve complex problems) and the forms and means adopted (e.g. integration of conceptual frameworks). This results in a more encompassing notion that also has the nice advantage of giving PhID [Philosophy of Interdisciplinarity] more work to do!”<sup>177</sup>

Contrary to the CIPI framework, Mäki uses the term ‘interdisciplinarity’ to denote any type of disciplinary interaction. ‘Interdisciplinarity’ now encompasses different subtypes, and is open to new additions that might arise from the observation of scientific practice. Whereas within the CIPI framework, the only type of interaction that could properly be termed ‘interdisciplinary’ is a CIPI-style interaction, Mäki opens up the term to include different forms of disciplinary interaction. One of these new types of interdisciplinarity which Mäki’s framework accounts for is ‘scientific imperialism’, a type of interdisciplinary interaction that will become essential to my analysis.<sup>178</sup> Note also that in the quote above Mäki emphasizes the fact that there is much work left to be done in the development of this new practical definition of interdisciplinarity. This is something I will take to heart, by introducing my own addition of disciplinary bridging in the next section of this chapter.

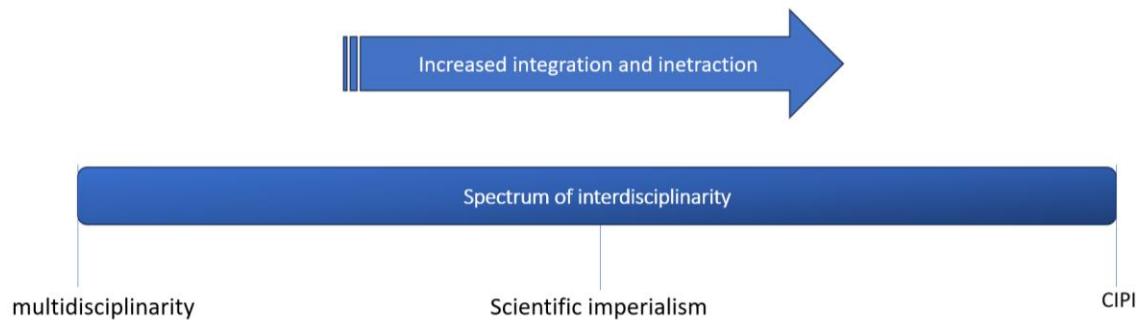
To properly contrast this alternative view of interdisciplinarity with the CIPI, I have created a graphic representation, which can be seen in Figure 1. Instead of restricting the term ‘interdisciplinary’ to CIPI, Mäki extends it to contain different types of interactions. Each of these interactions implies a different level of integration and communication between the disciplines concerned. Interdisciplinarity is now a broad spectrum. On one end of this spectrum, I could place what is traditionally called ‘multidisciplinarity’. As I explained in Chapter 1, within the CIPI framework, ‘multidisciplinarity’ is contrasted with ‘interdisciplinarity’. This is not the case in the new practical framework for interdisciplinarity, where ‘multidisciplinarity’ can be seen as a subtype of ‘interdisciplinarity’. On the other side of the spectrum, I could place the CIPI, which is now only considered a subtype of ‘interdisciplinarity’, one characterized by

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<sup>177</sup> Uskali Mäki, “Philosophy of Interdisciplinarity. What? Why? How?,” 331.

<sup>178</sup> Uskali Mäki, Adrian Walsh, and Manuela Fernández Pinto, eds. “Introduction,” In *Scientific Imperialism: Exploring the Boundaries of Interdisciplinarity: Routledge Studies in Science, Technology and Society* (New York: Routledge, Taylor & Francis Group, 2018), 2.

a very high level of integration and interaction. Somewhere between these subtypes lies Mäki's concept of scientific imperialism, an alternative type of interaction that cannot be accounted for by the CIPI framework. I have placed this subtype in the middle of the spectrum of interdisciplinarity, as it lacks the complete mutual indifference between disciplines characteristic of multidisciplinary, while also not conforming to the strict integrative ideal set out by CIPI. In doing this I follow Mäki's own placement of imperialism on the spectrum.<sup>179</sup>



**Figure 1:** A representation of Mäki's alternative conceptualization of interdisciplinarity as a spectrum. This spectrum includes different types of interdisciplinarity with differing amounts of integration and interaction between disciplines.

### *Mäki's Scientific Imperialism*

Throughout his career, Uskali Mäki has developed a comprehensive framework for a very specific type of interdisciplinary interaction, which he terms 'scientific imperialism'. Mäki did not invent the term but is one of the first philosophers who developed an analytical framework suited to the systematic description of practical case studies. Mäki's scientific imperialism started out as a framework for economics imperialism, which he later generalized to accommodate imperialism stemming from any discipline.<sup>180</sup> What I will be presenting here is a condensed account of Mäki's 'scientific imperialism'. In constructing this framework I have included references to his earlier papers about economics imperialism, but have only included the elements that are relevant to his later generalization.

<sup>179</sup> Uskali Mäki, Adrian Walsh, and Manuela Fernández Pinto (eds.), "Introduction," 2.

<sup>180</sup> Uskali Mäki, "Scientific Imperialism: Difficulties in Definition, Identification, and Assessment," *International Studies in the Philosophy of Science* 27, no. 3 (September 2013): 325–39.

<https://doi.org/10.1080/02698595.2013.825496>; Uskali Mäki, "Economics Imperialism: Concept and Constraints," *Philosophy of the Social Sciences* 39, no. 3 (September 2009): 351–80.

<https://doi.org/10.1177/0048393108319023>; Uskali Mäki and C. Marchionni, "Is Geographical Economics Imperializing Economic Geography?," *Journal of Economic Geography* 11, no. 4 (1 July 2011): 645–65. <https://doi.org/10.1093/jeg/lbq021>.

First and foremost I will establish Mäki's definition of imperialism. Very concisely put, Mäki defines scientific imperialism as follows:

**Scientific imperialism** is a form of disciplinary expansionism, where a discipline studies a phenomenon that is traditionally studied by a different discipline.<sup>181</sup>

Of course 'imperialism' is a term rife with negative connotations. In fact, the term was coined by John Dupré, who published an article called *Against Scientific Imperialism* in 1994, to warn scientists against the dangers of economics and evolutionary imperialism. In Dupré's view abstract concepts from both of these fields were being applied to disciplines where they simply didn't belong. Dupré deemed the application of abstract terms that originated in one discipline to a different domain to be characteristic of bad science.<sup>182</sup> This negative view of what was termed 'scientific imperialism' was expanded on in *Scientific Imperialism and the Proper Relations between the Sciences*, a publication by Steve Clarke and Adrian Walsh. In this article, Clarke and Walsh heavily lean into the negative political connotations the term implies.<sup>183</sup> Scientific imperialism, in their view, is an illegitimate occupation of another discipline's territory.<sup>184</sup> Although Mäki's framework is more nuanced than that of these authors, there is still a distinct normative component to his conceptualization of the term. Mäki distinguishes different types of imperialism, partly on normative grounds. This is why I have to make it very clear at this point that I will not be incorporating any normative aspect of this framework in my description of my case study. The aim of my thesis is to formulate the best description of my case study in terms of interdisciplinary interactions, not to judge the interaction at hand. In describing Mäki's framework, I will purposefully leave out these normative components. In what follows I will continue my description of Mäki's concept of scientific imperialism by distilling its purely descriptive content. I will introduce certain key concepts that will, for clarity's sake, appear in bold throughout my explanation. My focus on the descriptive content will sometimes result in definitions of these terms that differ slightly from Mäki's original description, as they reflect my interpretation of the original descriptive content.

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<sup>181</sup> Uskali Mäki, "Scientific Imperialism," 333.

<sup>182</sup> John Dupré, "Against Scientific Imperialism," *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association 1994*, no. 2 (1994): 374–81. <https://doi.org/10.1086/psaprocbienmeetp.1994.2.192948>.

<sup>183</sup> Steve Clarke and Adrian Walsh, "Scientific Imperialism and the Proper Relations between the Sciences," *International Studies in the Philosophy of Science* 23, no. 2 (July 2009): 195–207.

<https://doi.org/10.1080/02698590903007170>.; Uskali Mäki, "Scientific Imperialism," 329.

<sup>184</sup> Uskali Mäki, "Scientific Imperialism," 330.

Mäki's scientific imperialism is characterized by a distinctive motive. He proposes that, oftentimes, this extension of a discipline into a new domain is motivated by adherence to the ideal of **explanatory unification**. This is a term used by Mäki, which coincides with what I have termed the 'ideal of the unity of science' in Chapter 1.<sup>185</sup> I have already mentioned unification or integration as one of the characteristics of the CIPI, but a similar ideal also underpins Mäki's concept of scientific imperialism. However, this common motivation does not mean that scientific imperialism and CIPI-interdisciplinarity have to result in similar disciplinary interactions. Whereas a CIPI-style interdisciplinary interaction has to give rise to a multilevel theory constructed through explanatory unification, the same is not true for scientific imperialism. In other words, the result of this drive towards unification in scientific imperialism can vary, there is no set way that a theory that results from scientific imperialism should look.

In Mäki's original framework, he distinguishes between different types of scientific imperialism based on the types of explanatory unification that drive them. Mäki considers certain forms of explanatory unification to be characteristic of 'good' types of imperialism, and others of 'bad' types of imperialism.<sup>186</sup> However, as I have already established, I have no use for such a normative distinction. Nevertheless, certain terms Mäki uses in the description of these different types of imperialism are still very useful to me. In what follows I will describe certain concepts that Mäki created to describe and distinguish between specific subtypes of scientific imperialism. Contrary to Mäki, however, I will claim that these concepts are useful in the description of scientific imperialism in general, as I do not adhere to his normative distinction between types of imperialism.

The first interesting concept for the description of certain cases of scientific imperialism is what Mäki calls the violation of 'constraints'. The two constraints that are particularly interesting to me are his **epistemological constraint** and his **institutional constraint**.<sup>187</sup> Again, using the term 'violation of constraints' implies a normative judgment on Mäki's part, but this is not a connotation that I want to adhere to myself. What I take Mäki to indicate with 'the violation of the epistemological constraint' is simply the observation that, in cases of scientific

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<sup>185</sup> Uskali Mäki, "Explanatory Unification: Double and doubtful," in *Philosophy of the Social Sciences*, Vol 31 No. 4, (December 2001), 488; Uskali Mäki, "Economics Imperialism," 351-353; Uskali Mäki, "Scientific Imperialism," 336.

<sup>186</sup> Uskali Mäki, "Explanatory Unification: Double and doubtful," 488-506; Uskali Mäki, "Economics Imperialism," 362-370; Uskali Mäki, "Scientific Imperialism," 336.

<sup>187</sup> The two other constraints Mäki mentions are his ontological constraint and his axiological constraint. I will not be using these constraints because Mäki's ontological constraint is based on a normative judgment that I don't wish to adhere to, and his axiological constraint is based on an evaluation of the underlying scientific theory, something I am not qualified to do and falls beyond the scope of my philosophical/historical thesis.

imperialism, the imperializing discipline tends to make big claims when entering its new domain.<sup>188</sup> Oftentimes the idea behind such an expansion is that a significant intellectual contribution can be made by the imperializing discipline because the imperializing discipline sees itself as having legitimate epistemic authority within this new domain. This attitude often goes together with a limited amount of communication or institutional interaction between the disciplines concerned. This is what Mäki calls the ‘violation of his institutional constraint’.<sup>189</sup> When a discipline violates the institutional constraint, I take this to mean that the imperialized and imperializing disciplines are not mutually discussing their respective contributions to the domain in question. The disciplines concerned in the interaction are therefore not in explicit agreement over their standing towards each other.

The violation of this institutional constraint is usually accompanied by what Mäki calls **imperialism of style** and **imperialism of standing**. When a case of scientific imperialism displays signs of imperialism of style, research into the imperialized phenomenon starts displaying the research style, practices, and methodologies of the imperializing discipline. I take this to mean that new tools or styles of research, which might formerly not have been applied to the phenomenon in question, are imported by the imperializing discipline. Imperialism of style is also associated with imperialism of standing, where the imperializing discipline is held in high regard and popular within the institution.<sup>190</sup>

#### *Accommodating neuroscience imperialism*

Although Mäki began by constructing his framework for economics imperialism, it is clear from the beginning that he is building a framework that might be applicable to a number of other disciplines. In one of his papers, Mäki even specifically names neuroscience as one of the disciplines that, in certain cases, might benefit from an analysis in terms of scientific imperialism.<sup>191</sup> As my case study involves neuroscience, I believe it is worth illuminating some characteristics of neuroscience imperialism.

Conveniently enough, Mäki’s call for an examination of neuroscience imperialism is answered by Roberto Fumagalli in a contribution to the 2018 collection of essays on scientific

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<sup>188</sup> Uskali Mäki, “Economics Imperialism,” *Philosophy of the Social Sciences* 39, no. 3 (September 2009): 371-374, <https://doi.org/10.1177/0048393108319023>.

<sup>189</sup> Uskali Mäki, “Scientific Imperialism: Difficulties in Definition, Identification, and Assessment,” *International Studies in the Philosophy of Science* 27, no. 3 (September 2013): 337. <https://doi.org/10.1080/02698595.2013.825496>.

<sup>190</sup> Uskali Mäki, “Scientific Imperialism,” 333; Uskali Mäki, and C. Marchionni, “Is Geographical Economics Imperializing Economic Geography,” 648-649.

<sup>191</sup> Uskali Mäki, “Scientific Imperialism,” 325.

imperialism.<sup>192</sup> In his paper *Against Neuroscience Imperialism*, Fumagalli wants to call attention to the phenomenon of neuroscience imperialism and create a normative framework for its rejection in certain cases. Once again I am faced with a framework for a form of scientific imperialism that includes normative elements. However, I think that there is one specific descriptive element that Fumagalli applies to neuroscience imperialism specifically that I think is very relevant to the description of my case study.

In his discussion of neuroscience imperialism, Fumagalli voices the following opinion:

“NI [neuroscience imperialism] significantly overstate the evidential and explanatory relevance of neuroscience methods and findings for the disciplines they target. And second, many calls for NI point to an untenable reductionist position, which rests on unsupported empirical and normative presuppositions.”<sup>193</sup>

The descriptive elements of this quote can, in my view, largely be described in terms of Mäki’s constraints. I believe that Fumagalli claims that, within neuroscience imperialism, the violation of the epistemological constraint is common. Furthermore, Fumagalli points towards a form of imperialism of standing, where neuroscientific explanation is valued above other types of explanation. These two factors combined result in a new characteristic specific to neuroscience imperialism, namely a **strong reductionistic emphasis on the neuroscientific level** of explanation. I want to add this characteristic of neuroscience imperialism to the toolkit I will be using for the description of my case study, in addition to the concepts I borrowed from Mäki.

#### *A call for the identification of Mechanisms of scientific imperialism*

It is important to note that Mäki considers his framework of imperialism to be a work in progress. Just as for his framework for interdisciplinarity in general, new conceptual tools should be created to account for different aspects of scientific imperialism. In a 2018 collection of essays, Mäki and his co-authors introduce some of the main areas where contributions could be made. One of the standing issues within discussions around scientific imperialism is the identification of its mechanisms. The authors express that: “In trying to understand the phenomenon of scientific imperialism, questions regarding the mechanisms leading to its emergence and eventual end also arise. How and why does scientific imperialism originate, and

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<sup>192</sup> Roberto Fumagalli, “Against Neuroscience Imperialism,” In *Scientific Imperialism: Exploring the Boundaries of Interdisciplinarity* Uskali Mäki, Adrian Walsh & Manuela Fernández Pinto eds. (New York: Routledge, Taylor & Francis Group, 2018) 205-223.

<sup>193</sup> Roberto Fumagalli, “Against Neuroscience Imperialism,” 210-211.

how is it sustained and modified?”<sup>194</sup> This issue is something I believe I can actively contribute to in the discussion of my case study in terms of scientific imperialism.

I am now armed with the concepts of **unificatory explanation**, the violation of **the epistemological and institutional constraints, imperialism of style, imperialism of standing** and the observation that neuroscience imperialism often displays a **strong reductionistic focus on the neuroscientific level of analysis**. This toolkit will allow me to describe the development of mirror neuron empathy as a form of neuroscience imperialism and will enable me to formulate a new mechanism that could be added to this toolkit in the future, namely that of disciplinary bridging. What this new mechanism entails, is something that will become clear in the next section.

### **A description of the emergence of mirror neuron empathy in terms of scientific imperialism**

In the previous chapter, I have shown that the interdisciplinary interaction that gave rise to mirror neuron empathy could not be appropriately explained through the framework offered by the CIPI. I was left with a clear interaction between philosophy and neuroscience in the creation of the first theory of mirror neuron empathy. This, however, could not account for the full story of mirror neuron empathy, as this interaction was transitory in nature, as evidenced by the publications of Keysers and Iacoboni. These publications, which consolidated mirror neuron empathy as an enduring part of social neuroscience, did not display a thorough acknowledgment of the role philosophy played in its development. Furthermore, these articles should be seen in the context of a discrepancy in the theoretical and practical disciplinary attitude of social neuroscience toward social psychology. On the one hand, as I have shown in Chapter 1, social neuroscience claims to be the product of a CIPI interaction between neuroscience and social psychology, while in practice this interaction does not seem to exist within my case study. In what follows I will present the early history of mirror neuron empathy as the imperialization of social psychology by neuroscience within the domain of social neuroscience. I will claim that this imperialization was facilitated through a new mechanism which I will term ‘disciplinary

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<sup>194</sup> Uskali Mäki, Adrian Walsh, and Manuela Fernández Pinto, eds. “Introduction,” In *Scientific Imperialism: Exploring the Boundaries of Interdisciplinarity: Routledge Studies in Science, Technology and Society* (New York: Routledge, Taylor & Francis Group, 2018), 5.

bridging through philosophy’. In doing so I hope to account for the aspects of the early history of mirror neuron empathy which cannot be accounted for by the CIPI framework.

*A first step: Disciplinary bridging through philosophy as a facilitating mechanism for the imperialization of the domain of social neuroscience*

First and foremost, I believe that the formulation of mirror neuron empathy can accurately be described as a form of scientific imperialism. As per the definition of scientific imperialism, mirror neuron empathy is the result of a discipline, namely neuroscience, extending itself into the domain of another discipline, namely social psychology. It accomplishes this extension into the social domain through its formulation of a social neuroscientific mirror neuron theory of empathy. I believe that the first step towards this movement of imperialization was facilitated by a preliminary ‘bridging’ interaction with philosophy within Gallese’s work. I claim that neuroscientists first entered the social domain to study the phenomenon of empathy by bypassing social psychology and instead passing through the disciplinary bridge of philosophy. I believe that this mechanism of disciplinary bridging is likely for two reasons: a contextual historical reason and a second reason that relates to philosophy’s disciplinary characteristics.

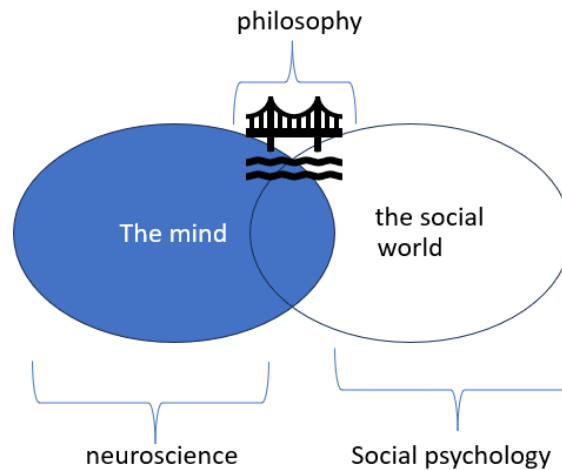
When I described the development of Gallese’s shared manifold hypothesis of empathy in Chapter 2, I situated this history within the context of the rich interactions between neuroscience and philosophy in the last decades of the 20th century. At the time of the discovery of mirror neuron empathy, philosophers and neuroscientists were actively collaborating within both the field of philosophy of mind and (neuro)phenomenology. Neuroscientists and philosophers worked on similar problems and met and communicated with each other in institutional settings such as conferences. It was at such a conference that Gallese first encountered Alvin Goldman, which ultimately resulted in Gallese’s mirror neuron theory of empathy. With this context in mind, I claim that at this time, philosophy was the most likely candidate for the facilitation of this neuroscientific extension into the social domain. As I have established in Chapter 1, neuroscientists were slowly looking toward an extension into the social domain at this time. This extension was described by social neuroscientists as one that could be facilitated by interaction with social psychology. The idea was that a sustained form of this interaction would ultimately lead to the establishment of the discipline of social neuroscience. However, within my case study, the actual interaction that led to the formulation of mirror neuron empathy was one between neuroscience and philosophy instead. I believe that



this observation is less surprising than one might think, seeing as the interaction between neuroscience and philosophy was already well-established.

In addition to this historical contextualization, I believe that there is a more fundamental reason that philosophy could be the facilitating bridge through which neuroscience could enter the social domain. This reason relates to philosophy's disciplinary scope. Philosophy as an academic discipline is characterized by its very broad domain. Imagine a random topic, and it is likely that a philosophical theory about this phenomenon has been formulated. For the sake of my case study, I want to point out that this broad disciplinary domain of philosophy includes both the domain of the individual mind, a domain that is also traditionally occupied by neuroscience, and the social mind, which is traditionally part of social psychology. Viewed like this, philosophy as a discipline shares parts of its domain with both neuroscience and social psychology and has a strong footing in both of these domains. As neuroscience and philosophy were already interacting on the level of the individual mind at the time of the development of theories of mirror neuron empathy, I believe it was no great leap to extend this interaction to the development of a social theory, namely mirror neuron empathy. Gallese's interaction with philosophy then allowed Gallese to transport his neuroscientific concept of mirror neurons, into the social domain of empathy. Philosophy therefore acted as a 'disciplinary bridge', grounded in both the domain of social psychology and neuroscience. I have represented a simplified version of this mechanism in Figure 2.

It should be noted that I call this mechanism 'disciplinary *bridging*' because philosophy allowed neuroscientists to circumvent interaction with the discipline of social psychology in its formulation of mirror neuron empathy. Mirror neuron empathy was later claimed by the discipline of social neuroscience as one of its important foundational research programs, but the initial formulation of this theory shows a bridging of social psychology, instead of the expected CIPI-interaction with social psychology. By allowing neuroscientists to circumvent actual interaction with social psychological theory, and pass through the 'bridge' of philosophy instead, social neuroscientific mirror neuron research could be established without significant input from social psychology. I believe that it is this circumvention that later facilitated the imperialization of social psychology by neuroscience within the discipline of social neuroscience, at the very least in the case of mirror neuron empathy.



**Figure 2:** a simplified representation of the domains of neuroscience (pre-social neuroscience), philosophy and social psychology showing how philosophy could have been a disciplinary bridge for neuroscience imperialism into the social world.

*Empirical Proof of the circumvention of social psychology: A comparison between social psychological theories of empathy and mirror neuron empathy*

I believe that the mechanism of disciplinary bridging through philosophy is strongly supported by my presentation of the development of Gallese’s interpretation of mirror neuron function in chapter 2. As I explained in Chapter 2, there is a complete lack of mention of social psychological theory within the corpus and citations of Gallese’s work. To make my case for the circumvention of social psychology even stronger, however, I want to briefly comment on some core differences between one of the most influential theories of empathy and Gallese’s mirror neuron empathy.

An influential social psychologist who formulated an important social psychological theory of empathy is Martin Hoffman. As I have already mentioned in the introduction, Hoffman identifies empathy as an ‘as if’ process, where the observer through observing another individual experiences an affective response that is more suited to the target than to the observer.<sup>195</sup> However, for Hoffman empathy is not an innate function of the human mind, but instead is characterized by different developmental stages. Each of these stages is being facilitated by many different mechanisms. Similarly to Gallese, Hoffman sees a role for ‘mimicry or imitation’ in his definition of empathy. However, this is where the similarities end.

<sup>195</sup> Martin L. Hoffman, “Toward a Theory of Empathic Arousal and Development,” In *The Development of Affect*, edited by Michael Lewis and Leonard A. Rosenblum (Boston, MA: Springer US, 1978), 229. [https://doi.org/10.1007/978-1-4684-2616-8\\_9](https://doi.org/10.1007/978-1-4684-2616-8_9).

Whereas Gallese, on the one hand, describes his mental simulation routine as a basis for empathy facilitated by mirror neurons, Hoffman, on the other hand, sees mimicry as only one of the many components of the development of an early stage of empathy. Mimicry is important for Hoffman, but mimicry alone is not a sufficient condition for the development of fully-fledged empathy. Other factors equally play a role in Hoffman's theory.<sup>196</sup> Gallese on the other hand makes no distinctions between different developmental stages of empathy and hinges his entire mirror neuron theory of empathy on the mechanism of mental mimicry facilitated by mirror neurons. This means that by unifying every type of empathy under one mechanism of mental mimicry, Gallese's theory completely lacks both the developmental component and the plurality of factors which are a core part of Hoffman's social psychological theory. Once again, this time on the content level, the lack of interaction between social psychology and Gallese is palpable. This is not to say that mirror neuron empathy could never be amended to fit such a theory, but in its first development, these theoretical differences once again prove that social psychological theories of empathy were not on Gallese's radar.

*A second step: Imperialization facilitated by disciplinary bridging*

When Gallese's successors took over the study of mirror neuron empathy, social neuroscience was beginning to take on the characteristics of a more developed discipline. In my view, this means that their publications can be seen as early contributions to a more solidified interdisciplinary discipline of social neuroscience. However, after the bridging process through philosophy, there seems to be a notable lack of interdisciplinary interaction in the works of Keysers and Iacoboni. Still, this non-interaction with social psychology in practice cannot be seen as disinterested multidisciplinary, as social neuroscience explicitly proclaims to have entered a disciplinary relationship with social psychology. In my opinion, this interaction can best be described as the imperialization of social psychology by neuroscience, specifically within the discipline of social neuroscience. In the following paragraphs, I will describe certain features of the further development of mirror neuron empathy, using the vocabulary provided to me by Mäki and Fumagalli, while simultaneously connecting these concepts to my mechanism of disciplinary bridging.

The formulation of Gallese's first theory of mirror neuron empathy resulted in its rooting by Keysers and Iacoboni into the burgeoning new discipline of social neuroscience. I think that one of the root causes of this expansion of neuroscience into the social domain is a drive toward

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<sup>196</sup> Martin L. Hoffman, "Toward a Theory of Empathic Arousal and Development," 227-256.

explanatory unification. Although I see Gallese's interaction with philosophy as a bridging mechanism that preceded and facilitated neuroscience imperialism within social neuroscience, I think certain imperialistic characteristics are already present in his work. In my interpretation, Gallese's construction of his manifold hypothesis can be described as a movement of 'explanatory unification', through his unification of different forms of empathy, all underlaid by one single mirror neuron mechanism. Gallese himself puts this in terms of evolutionary argumentation, arguing that it is more evolutionarily plausible for a neural mechanism to be repurposed along its evolutionary history, than for entirely new capabilities to materialize. Nevertheless, on an abstract level, this still implies a favoring of unificatory explanations over pluralist explanations.<sup>197</sup>

Furthermore, I think that the formulation of such an encompassing form of empathy, underlain by a single neural mechanism, could have been attractive to Gallese's successors, and might have been one of the reasons for its persistence within their work. Proof that this unified empathy might have been attractive to later neuroscientists can be found in two articles I mentioned in the previous chapter: the 2004 paper, *A Unifying View of the Basis of Social Cognition* in which Keysers collaborated with Gallese, and a 2006 follow-up publication *Towards a Unifying Neural Theory of Social Cognition*.<sup>198</sup> In both of these articles, Keysers and his co-authors express their hope that mirror neuron mechanisms could provide a basis for understanding many forms of social cognition. Mirror neurons are posited as the basis for understanding other people's actions, intentions, and emotions. This combination of factors should sound familiar to the reader, as this is essentially the same unified form of empathy that Gallese proposed in his *Shared Manifold Paper*. Further evidence for this correspondence is the fact that Gallese collaborated on the 2004 paper. Additionally, when looking at the literature I presented as representative of the work of Gallese's successors, mirror neurons are applied to affective and cognitive empathy alike while also still retaining their function in action

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<sup>197</sup> Vittorio Gallese, "The 'Shared Manifold' Hypothesis: From Mirror Neurons To Empathy," *Journal of Consciousness Studies*, 8 No.5-7. (2001) 40-41.

<sup>198</sup> Vittorio Gallese, Christian Keysers, and Giacomo Rizzolatti, "A Unifying View of the Basis of Social Cognition," *Trends in Cognitive Sciences* 8, no. 9 (September 2004): 396-403.

<https://doi.org/10.1016/j.tics.2004.07.002>; Keysers, Christian, and Valeria Gazzola, "Towards a Unifying Neural Theory of Social Cognition," *Progress in Brain Research*, 156 (2006) :379-401 [https://doi.org/10.1016/S0079-6123\(06\)56021-2](https://doi.org/10.1016/S0079-6123(06)56021-2).

understanding.<sup>199</sup> Clearly, mirror neurons continued to function as the unifying element for any form of empathy after the formulation of Gallese's 'Shared Manifold' hypothesis.

I want to remark here that a drive towards unification is a characteristic shared by CIPI-style interdisciplinary interactions and scientific imperialism. I believe this similarity is worth pointing out because it might help explain why social neuroscientists conceptualize their discipline through the CIPI framework. I would venture to say that social neuroscientists might have been correct in portraying their discipline as driven by an urge for unification, but incorrect in assuming that this urge resulted in a CIPI-style interdisciplinarity.

As I discussed in a previous paragraph, the unified mirror neuron empathy did not correspond to the concept of empathy common within social psychology. In view of this, I would frame Gallese's theory and its successors as rather significant claims to the explanation of the phenomenon of empathy. In other words, I believe that the formulation of mirror neuron empathy can be said to violate the epistemological constraint. Furthermore, I believe that this violation can be explained through a combination of its imperialistic drive towards unification and the disciplinary bridging through philosophy. First, I have shown in Chapter 1 that unification was an important disciplinary aim for social neuroscientists. Theories which could explain more phenomena using a minimum amount of explanatory elements would automatically have been favored above pluralistic ones. Secondly, neuroscientists never even came into contact with these more pluralistic theories of empathy, as they entered the social domain of empathy through interaction with philosophy. I believe that the combination of these two factors sets the scene for the violation of the epistemological constraint within these theories of empathy.

Aside from connecting disciplinary bridging to an imperialistic urge towards explanatory unification and the violation of the epistemological constraint, I also believe that disciplinary bridging might be at the root of the imperialism of style exhibited in Iacoboni and

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<sup>199</sup>Jonas T. Kaplan and Marco Iacoboni, "Getting a Grip on Other Minds: Mirror Neurons, Intention Understanding, and Cognitive Empathy," *Social Neuroscience* 1, no. 3–4 (September 2006): 175–83. <https://doi.org/10.1080/17470910600985605>; Laurie Carr, Marco Iacoboni, Marie-Charlotte Dubeau, John C. Mazziotta, and Gian Luigi Lenzi, "Neural Mechanisms of Empathy in Humans: A Relay from Neural Systems for Imitation to Limbic Areas," *Proceedings of the National Academy of Sciences* 100, no. 9 (April 29, 2003): 5497–5502. <https://doi.org/10.1073/pnas.0935845100>; Bruno Wicker, Christian Keysers, Jane Plailly, Jean-Pierre Royet, Vittorio Gallese, and Giacomo Rizzolatti, "Both of Us Disgusted in My Insula: The Common Neural Basis of Seeing and Feeling Disgust," *Neuron*, Vol. 40, No.3 (2003) 655-664, doi:10.1016/s0896-6273(03)00679-2.

Keyser's work. In Chapter 2 I mentioned that the mirror neuron empathy research after The Shared manifold Hypothesis, retains the methods and style of classic neuroscientific publications. I believe that this imperialism of style can equally be understood as a consequence of the bridging mechanism. I think it is plausible that considering the bridging through philosophy, a notoriously theoretical discipline, the methods and style of the empirical side of purely neuroscientific mirror neuron theory could remain unaltered. Through interaction with philosophy, one could hardly expect neuroscientists to be materially influenced by philosophical empirical research methods, as these, generally speaking, don't exist. When, hereafter mirror neuron empathy became established as a research field within social neuroscience, the scene was set for a form of imperialism of style, because of this lack of interaction with another empirical discipline in its initial construction.

Another aspect that is worth noting given the imperialism of style and the violation of the epistemological constraint, is the general excitement surrounding neuroscientific research between the 1990s and early 2000s. As I explained in my first chapter, the '90s had been The Decade of the Brain', and had given an impulse to neuroscientific research which was still in effect in the early 21<sup>st</sup> century. To me, this indicates that the imperialism of style displayed in mirror neuron research could in part be explained by these signs of imperialism of standing. Quite simply put, neuroscientific explanations for phenomena were 'in style' when mirror neuron empathy rose to prominence. There is literature that further suggests that neuroscientific explanations tend to be favored over psychological explanations that don't contain a reference to the neural level of analysis.<sup>200</sup>

Finally, I think that all the abovementioned factors were further reflected in the strong focus on the neuroscientific level within the content of later mirror neuron empathy publications. Instead of including the level of social psychology in their conceptualization of empathy, as their parent discipline promises, social neuroscientists like Keyser and Iacoboni nearly exclusively draw from the neuroscientific level of analysis in their theorizing about empathy. This is a point I have discussed in Chapter 2, and which I believe can be made more intelligible using the analysis above. Firstly, I believe that this strong reductionistic focus on the neuroscientific level of explanation can be seen as a consequence of the unificatory impulse

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<sup>200</sup> Deena Weisberg et al., "The Seductive Allure of Neuroscience Explanations," *Journal of Cognitive Neuroscience* 20, no. 3 (2008): 470-477.

I described at the beginning of this section. The neural level of analysis is the level that makes the unification of empathy possible, making it plausible that it would have special appeal for later researchers. Secondly, as I have already mentioned, I take this drive towards unification as a potential contributor to the violation of the epistemological constraint, which in this case looks like an over-emphasis on the unifying neural mechanism. This combined with the imperialism of standing I described in the previous paragraph, and the imperialism of style present in Keyzers and Iacoboni's work, leaves me with the description of an interaction that looks much like Fumagalli's portrayal of neuroscience imperialism. Imperialism of style and standing combined with a drive towards unification which can result in the violation of the epistemological constraint, manifested in a strong reductionistic focus on the neuroscientific level of explanation. I believe that all these factors together suggest that the early history of mirror neuron empathy is best described as neuroscience imperialism within the field of social neuroscience, facilitated by disciplinary bridging through philosophy.

### **Neuroscience Imperialism within social neuroscience in general**

In this last section, I want to describe certain features of social neuroscience in general, using the same conceptual toolbox I used in the description of mirror neuron empathy. I wish to suggest that my case study could be representative of the development of its entire parent discipline. In this, I am not saying that the mechanism of bridging is necessarily representative of the whole of social neuroscience, but I do want to suggest that in view of my case study, the history of social neuroscience could be investigated through the lens of (neuro)scientific imperialism.

First I want to point out that within the literature reviews for chapter 1, in which I discussed social neuroscience's self-concept, almost every publication I used was written by researchers primarily involved in neuroscientific research. A notable exception here is John T. Cacioppo, the author of the very first article which mentions social neuroscience, who had worked together with social psychologist Elaine Hatfield.<sup>201</sup> However, in later publications that I used in writing this section, the authors are primarily involved in research on the neuroscientific level of analysis. It seems to me that in the outlining of the discipline's aims neuroscientists might have been overrepresented, which potentially could have led to some signs of the violation of the institutional constraint. The construction of social neuroscience by

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<sup>201</sup> Elaine Hatfield, John T Cacioppo, and Richard L Rapson. *Emotional Contagion* (Cambridge: Cambridge University Press, 1994)

neuroscientists suggests a possible lack of input from the discipline of social neuroscience on an institutional level.

This idea is further corroborated by some of the later literature I used when detailing the history of social neuroscience, which occasionally mentions a similar lack of interaction. Oschner and Lieberman, for example, have noted that “the amount of cross-disciplinary communication is still small and is hardly sufficient to ensure the health of this fast-growing nexus of research (i.e. social neuroscience).”<sup>202</sup> They further warn against the dangers of inadequate communication and collaboration between the fields in making appropriate advances.<sup>203</sup> Similarly, Matusall et al. note what they call the ‘neuralization’ of social sciences, and offer up the question of its effects on the existing fields. They further mention that “today, the position of [...] established disciplines within social science toward social neuroscience often lies between ignorance and hostility.”<sup>204</sup>

Lastly, the emergence of social neuroscience in general is, by its own admission, the expansion of the domain of neuroscience onto the social domain, which in Mäki’s terms translates to an imperialization of the social domain by neuroscience. Furthermore, I want to point out that some of the factors I brought up in my description of imperialism in mirror neuron empathy, also apply to social neuroscience in general. Imperialism of standing could apply to many case studies for example, and so could the drive towards unification. Looking back at Chapter 1, for example, Ramachandran specifically heralds the discovery of mirror neurons as a breakthrough in social neuroscientific research due to its unifying potential.

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<sup>202</sup> Kevin N. Oschner and Matthew D. Lieberman, “The Emergence of social Cognitive Neuroscience,” *American Psychologist* Vol. 56, No. 9 (2001), 718.

<sup>203</sup> Kevin N. Oschner and Matthew D. Lieberman, “The Emergence of social Cognitive Neuroscience,” 718.

<sup>204</sup> Svenja Matusall, Ina Maria Kaufmann, and Markus Christen, “The Emergence of Social Neuroscience as an Academic Discipline,” 23.



# Conclusion

In this final recapitulation of my thesis, I want to retrace the main lines of my argument. My aim in this paper was to describe the emergence of mirror neuron empathy as an important research program within social neuroscience through a suitable description of the interdisciplinary interactions that were constitutive of its history.

As a discipline that defines itself in terms of interdisciplinarity between social psychology and neuroscience, social neuroscience follows a classical theoretical framework for interdisciplinarity, which I have termed CIPI. Because mirror neuron empathy is considered one of the foundational research programs of social neuroscience, the CIPI framework seemed to be an obvious candidate for its description in terms of interdisciplinarity. However, a closer inspection of the history of early mirror neuron empathy revealed that the scientific practice of the development of mirror neuron empathy was not consistent with the CIPI-ideal set out by its parent discipline. Firstly, contrary to social neuroscience's self-concept, the early history of mirror neuron empathy was not characterized by a CIPI-style interaction between social psychology and neuroscience. Instead, the first theory of mirror neuron empathy was constructed by a transitory interaction with philosophy. Furthermore, early successors of this theory did not display interaction with any other non-neuroscientific discipline. Secondly, I established that this history is not only incommensurable with social neuroscience's self-concept, but that it cannot accurately be described as a CIPI interaction at all. Briefly put, what happened in the practice of the development of mirror neuron empathy does not line up with the theoretical expectations about its interdisciplinarity.

This inadequacy of CIPI for my descriptive purpose led me to introduce an alternative, empirically based framework for interdisciplinarity, mainly based on Uskali Mäki's work. This new framework attempts to close the chasm between theoretical notions of interdisciplinarity, and its manifestation within actual scientific practice. Using this framework, I introduced a new notion of 'interdisciplinarity' defined as a spectrum that contains a range of different subtypes of interdisciplinary interaction. One of the subtypes, namely scientific imperialism, I considered to be especially relevant for my case study. After distilling some descriptive tools from Mäki's framework for scientific imperialism, I recounted the early history of mirror neuron empathy through this new practical framework for interdisciplinarity while making use of the vocabulary of scientific imperialism. I described the emergence of mirror neuron empathy in two stages:

First by its transitory interaction with philosophy, which I termed ‘disciplinary bridging’. Through this first step, neuroscience could bypass the discipline of social psychology in its first formulation of a mirror neuron theory of empathy, while still entering the social domain. Secondly, I claim that this bridging mechanism facilitated (neuro)scientific imperialism of social psychology within the domain of social neuroscience. I described some of the details of early mirror neuron empathy using Mäki’s framework while connecting these observations to the bridging mechanism. This final description now leads me to claim once more that the emergence of mirror neuron empathy is best described using a practical framework for interdisciplinarity which allows for its description as a case of neuroscience imperialism facilitated by disciplinary bridging through philosophy.

As I mentioned in my introduction, I believe that my description of the emergence of mirror neuron empathy, using a practical notion of interdisciplinarity, is a valuable contribution to recent discussions surrounding the applicability of CIPI-style frameworks to the description of scientific practice. I argue that because my case study could not be adequately described using the CIPI framework, I have added to the existing claim that alternative frameworks for interdisciplinarity are necessary if we wish to accurately reflect its scientific reality. To accurately describe the early history of mirror neuron empathy, I needed a more flexible framework than CIPI, one that prioritizes empirical fact over theoretical ideal. Moreover, I believe that the flexibility of the practical spectrum of interdisciplinarity allowed me to formulate my mechanism of disciplinary bridging. Within this new practical philosophy of interdisciplinarity, it is generally acknowledged that practical observation will lead to new contributions to the framework. Encouraged by this open attitude, I was able to represent a nuanced description of the complex interactions involved in my case study, partly because it allowed me to formulate my own concept of disciplinary bridging.

A second important consequence of my claim relates to the self-concept of the discipline of social neuroscience. As I have shown, its disciplinary ideals do not align with its practice. I hope to have made this very obvious for my case study, but also believe that my description of mirror neuron empathy has implications for social neuroscience in general. I have two reasons to believe this: Firstly, mirror neuron empathy is considered a significant aspect of social neuroscience. Secondly, in my previous chapter, I have briefly demonstrated that certain characteristics of mirror neuron empathy described in terms of scientific imperialism also apply to social neuroscience as a whole. Therefore, I believe that my assertion challenges both the CIPI framework in general and its specific application within the self-concept of social

neuroscience. Of course, it is very possible that in other cases of social neuroscience the interactions at hand looked different, and conformed more to its ideal. However I want to suggest that based on my case study, further comparative research into social science's self-concept and its relation to the scientific practice is warranted.

Aside from contributing to the debate around the philosophy of interdisciplinarity and the self-understanding of social neuroscience I also want to illuminate a couple of auxiliary results of my research. To begin with, my case study is the first detailed case study of neuroscience imperialism. In my third chapter, I pointed out that there exists a demand for the description of such case studies. I believe that this paper supplies just that. Furthermore, I believe that my reconstructed the evolution of mirror neuron empathy from its inception is a novel contribution to the history of social neuroscience.

Of course, the results of my research have inevitably left me with several new questions and observations deserving of attention within further research. First and foremost, I believe that it would be relevant to research reactions to the emergence of social neuroscience and mirror neuron empathy within the discipline of social psychology outside of its (non)-involvement in social neuroscience. It could be relevant to see in what ways later social psychological researchers might have adopted or rejected mirror neuron empathy and neuroscientific input. Were social psychologists forced to admit a certain degree of imperialization in later years, or did they metaphorically close their disciplinary borders? Considering the response of social psychologists would give us a broader picture of the interdisciplinary interactions relevant to my case study. Within my research, I have restricted my scope to the interactions within social neuroscience specifically, but considering social psychology as a whole might offer some indications about the question of whether neuroscience imperialism of social psychology within social neuroscience could be extended to neuroscience imperialism within social psychology as a whole. I specifically recommend research into institutional indicators of imperialism, such as increased funding for neuroscientifically based research, and imperialism of style within social psychology. These are all issues that could further illuminate the extent and reach of neuroscience imperialism within the social domain.

Another caveat in this context is the question of what exactly social neuroscientists understood by 'social psychology' when they proclaimed their discipline to be a CIPI-style interaction between social psychology and neuroscience. In the articles I reviewed for this thesis, there were many references to social psychology as one of the most important contributors to social neuroscience. This is why, as mentioned in my introduction, I decided to

focus on the specific interaction between neuroscience and social psychology as representative of social neuroscience. However, given my results, it would be relevant to ask if the neuroscientists who wrote these articles had a different notion of what constitutes social psychology. As I already mentioned, I did not consider disciplines such as experimental psychology and neuropsychology as relevant to the study of social neuroscience, as I don't see these branches of psychology as part of social psychology. Nevertheless, it could be that social neuroscientists would disagree with this assessment. More research into the state of social psychological research and its disciplinary self-concept at this time could shed more light on this topic. Furthermore, investigating this terminological concern could also help explain why social neuroscience insists on a self-concept that includes a CIPI-style interaction between social psychology and neuroscience.

Additionally, I believe it is worth investigating whether there is a link between the interdisciplinary interactions that led to the development of mirror neuron empathy and its widespread popularity. As mentioned in the introduction, the connection between mirror neurons and empathy is not an inescapable fact dictated by inevitable scientific reasoning. Instead, some researchers have expressed skepticism about its validity. This now begs the question as to how mirror neuron empathy became such a popular theory of empathy. I believe that social factors are a likely contributor to its success. Given this information, I believe that my description of early mirror neuron empathy in terms of interdisciplinarity could lead the way toward answering this question.

Finally, In the previous chapter, I discussed Uskali Mäki's framework for scientific imperialism, which includes a normative component that distinguishes between 'good' and 'bad' forms of scientific imperialism. Typically, conversations on scientific imperialism contain ethical considerations. In this thesis, I have refrained from incorporating this ethical component into my depiction of Mäki's framework and have also avoided passing judgment on the interdisciplinary interactions at hand. Nevertheless, it would be interesting to examine whether the interdisciplinary interactions I described for mirror neuron empathy and hinted at for social neuroscience, in general, reveal any problematic aspects. It might be relevant to note that the violation of the mentioned constraints and the characteristics of imperialism of style and standing indicate that this interaction could potentially be classified as problematic in Mäki's view. However, I myself refrained from taking any position on this issue and will leave this determination to future studies on this topic.

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