ABSTRACT

GRUBER, DAVID ROBERT. Neurorhetoric and the Dynamism of the Neurosciences: Mapping Translations of Mirror Neurons Across the Disciplines. (Under the direction of Dr. Jason Swarts).

After several impressive decades of advances in the cognitive neurosciences, recent years have witnessed numerous cross-disciplinary engagements with brain findings. As a result, this dissertation sets out to explore how diverse fields of study are now building new theories, practices, and technologies from the neuroscience of "mirror neurons." In the mid-1990s, several Italian researchers discovered a "mirroring" phenomenon as the same areas of a monkey's brain activated when it saw an action as when it completed that same action. This discovery prompted theories about the neurobiological processes involved in the capabilities of monkeys and humans to mimic each other, to identify with each other, and to understand each other's actions. The work reported here explores how this neuroscience research is re-interpreted and used differently in multiple fields of study.

The project takes the concept of "translation" from Actor-Network Theory to guide a quantitative descriptive textual analysis and a qualitative rhetorical analysis of peer-reviewed journal articles from four fields using mirror neurons: Robotics Engineering, Phenomenology, Group Analysis, and Movement Therapy. The study seeks to understand how this neuroscience research is "translated" anew into these non-neuroscience fields and is made to "fit" into existing discourses while remaining subject to a field's institutional and philosophical politics. Ultimately, the aim of the study is to examine how and why mirror neurons are used and interpreted differently across these disciplinary contexts. The study leads to the suggestion that fields turning to neuroscience—including Rhetoric—would benefit from analyzing how field-specific discourses and practices combine to make

neurobiology appear “real” to the field and differently “real”—that is, the study exposes the rhetorical processes that contribute to multiple ontologies of neurobiological entities, throwing into suspicion claims about singular or realist interpretations of neurobiology.

Neurorhetoric and the Dynamism of the Neurosciences: Mapping Translations of Mirror Neurons Across the Disciplines

by
David Robert Gruber

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APPROVED BY:

Jason M. Swarts, Ph.D. Chair of Advisory Committee	William J. Kinsella, Ph.D.
Jordynn Jack, Ph.D.	Carolyn R. Miller, Ph.D.
David M. Rieder, Ph.D.	

BIOGRAPHY

David Gruber is a rhetorical scholar with an interest in the rhetoric of science, philosophy of technology, and more specifically, neuro-rhetorics and the medicalized body. David was born in Ashtabula, Ohio in 1979 and later moved to Vero Beach, Florida where he spent his early childhood and later returned to attend high school. After turning eighteen, David ventured out to the west coast. He attended Biola University where he received a B.A. in Communication Studies. Soon afterward, David took a position as an assistant to a literary agent in Beverly Hills and worked behind the scenes to support the careers of several prominent novelists. Deciding to go back to school, David earned a Master of Professional Writing degree from the University of Southern California. There, he wrote short stories and poems largely revolving around the theme of fear and its relationship to emerging technologies. After completion of his degree, David taught as an Adjunct Professor of Writing at several colleges in Los Angeles. Since beginning his doctoral studies at North Carolina State University in 2008, he has published research papers in *Media History*, *Visual Communication Quarterly*, and *POROI*, all dealing with the human body and its relationship to technics. David has given presentations at Rhetoric Society of America (RSA), National Communication Association (NCA), the Conference on College Composition and Communication (CCCC), and the Modern Language Association (MLA).

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CHAPTER 1:

THE RISE OF THE NEUROSCIENCES AND THE CHALLENGES OF A NEUROSCIENCE OF RHETORIC

On July 7th, 1990, George H.W. Bush signed Presidential Proclamation 6158, which stated that the 1990s were to be called the "Decade of the Brain." This grand proclamation followed both from Howard Gardner's (1985) insistence on a future "cognitive revolution" in the field of psychology and from a "growing awareness of the prevalence of diseases of the brain" (Fahnestock, 2005, p. 16). Earlier that same year, Seiji Ogawa and his research group announced their discovery that Magnetic Resonance Imaging (MRI)—standard for viewing static anatomic structures since the 1980s—could be modified to detect changes in levels of deoxygenated hemoglobin in blood, an effect called blood-oxygenation-level-dependent (BOLD) contrast (Heuttel et al., 2004, p. 12). Ogawa's discovery resulted in the creation of the functional magnetic resonance imaging machine (fMRI), revolutionizing the brain sciences and moving the study of the brain from a largely structural one to a joint focus on structures and processes (Brown, 2010; Van Horn, 2004). Researchers were, from then on, capable of conducting non-invasive experiments on living individuals that would visualize processes occurring at different levels beneath the skull, enabling inquiry into the tie between brain functions and mental activities (Raichle, 2009).

The "cognitive revolution" of the 1990s has now transformed into a "neuroscientific turn" within the academy. Researchers from fields such as engineering, biochemistry, computer science, and economics have been combining their experimental designs with the

full suite of visualization technologies now available— including the MRI, fMRI, electroencephalogram (EEG) and positron emission tomography (PET)—launching multiple investigations of the nervous system, emotion, cognition, and the interplay between them, while searching for connections to existing facts and theories from their own fields. The result is a multiplicity of new disciplines with names such as neuroengineering, neuroinformatics, and neuroeconomics (Jack & Appelbaum, 2010). As the editor of *Social Cognitive and Affective Neuroscience* puts it, neuroscientists are now "breaking bread" with those outside of the biological and medical disciplines, developing new areas for interdisciplinary research (Lieberman, 2006, p. 1).

As a result, it is not uncommon to encounter "the conviction that quite soon scientific approaches to the human brain will transform or even supersede cultural, philosophical, literary, or 'folk' explanations of human phenomena" (Slaby, 2010, p. 398). Indeed, the neurosciences "are only gaining in popularity" (Jack, 2010, p. 412), and have been met with great enthusiasm, evinced by the prefix "neuro" entering into liberal usage across the disciplines (Restak, 2006; Iacoboni, 2008; Johnson & Littlefield, 2011). Although there remains a diversity of reasons for taking up neuroscientific findings in non-neuroscience fields, "what draws them [neuro-disciplines] together is the use of the brain as a means to answer old questions and/or to open up new avenues of inquiry about society, culture, or human behavior" (Johnson and Littlefield, 2011, p. 2). The field of rhetoric is no exception.

Rhetoric's Approach to the Neurosciences

Jordynn Jack and Gregory L. Appelbaum have pointed out two reigning approaches in rhetoric to studying "all things –neuro" (413). The first is "the rhetoric of neuroscience"—the "inquiry into the modes, effects, and implications of scientific discourses about the brain" (413). The second is "the neuroscience of rhetoric"—the drive for "new insights into language, persuasion, and communication from neuroscience research" (413). Together, these two approaches forge the sub-field of "Neurorhetoric," wherein rhetorical scholars are able to move back and forth between analyzing work "with a rhetorical as well as a scientific lens" and seek to learn "how knowledge is established rhetorically and empirically in the field of cognitive neuroscience" (414).

The first half of what is called Neurorhetoric—the rhetoric of neuroscience—has precedent in the rhetoric of science more generally and follows from work by scholars such as Leah Ceccarelli (2001b), Alan Gross (2002), Carolyn Miller (1992), Lisa Keranen (2010), and Lawrence Prelli (1989). Interest in a rhetoric of neuroscience also finds support in recent calls for rhetorical scholars to pay special attention to neuroscience publications (Fahnestock, 2006; Gibbons, 2007; Gruber et al., 2011). And without question, the attendant research has thus far proven both productive and interesting. Jack (2010), for instance, examines the construction of autism in cognitive neuroscience by exploring the way multiple studies into autism primarily choose male participants and organize autism as a disorder of the "extreme male brain," reifying a gender bias about the constitution of males and females (p. 421-423). Davi Johnson (2008), to take another example, has explored how brain imagining is a

"persuasive visual rhetoric" that contributes to the "self-fashioning" of "desirable selves" (p. 147). And Michelle Gibbons (2007) has revealed how brain images argue differently as they move from academic journals to popular science publications (p. 175). In short, the rhetoric of the neurosciences is starting to flourish, and rhetorical scholars will continue to explore how the language and practices of the neurosciences allow it to hold together and influence audiences.

The second half of Neurorhetoric—the neuroscience of rhetoric—has less precedent in the field of rhetoric.[1] This is at least partially due to the complicated historical relationship with the sciences going back to Alan Gross' statement in the 1990s that science is "rhetoric without remainder" (1997, p. 6), or if one chooses to trace the tension back through time, then Plato's rejection of rhetoric in pursuit of objective knowledge might be the earliest possible yet influential starting point in Western intellectual history (Eades, 1996). Celeste Condit (1996) sums up the traditional tension this way: "the 'scientific' view ascribes objective, permanent, and universal status to the facts produced by scientists, whereas the 'sophistic' view supported by many rhetoricians describes facts as products of social conditions, and therefore marked by inter-subjectivity, transience, and situational delimitations" (p. 83). Bridging these epistemological views has, nevertheless, found some conditions for improvement as scientists increasingly recognize that their work is contingent and dependent upon cultural mediation (Nunes, 2003; Marcum, 2008; Verhoeven et al.,

[1] This is not to suggest that sciences of the brain have not been taken-up by individual researchers in Composition or in English Departments more generally. Janet Emig, to take one example, has tried to use neuroscientific insights in the field of Composition (See Emig, 1977); however, the claim made here is that the trend toward a specific and well-defined engagement in rhetoric as seen in a "neurorhetoric" is a new development.

2009) and as rhetorical scholars increasingly call for engagement with the sciences (Brady, 2004; Segal, 2005) and attend to the multiplicity of other disciplinary calls for interdisciplinary engagement (Shoenberger, 2001; Frodeman & Micham, 2007).

The Neuroscience of Rhetoric and Potential Challenges

Invoking the neurosciences in rhetoric now engenders excitement, and it seems that rhetoric follows the larger cultural belief that discoveries about the workings of the human brain retain the power to advance or overturn old perspectives and theories. Jenny Edbauer Rice (2008), for instance, suggests that neuroscientific findings into the non-conscious processes of the human affect may advance rhetorical theory. She argues that rhetorical scholars could use interdisciplinary resources from the sciences to consider the way affect transfers back-and-forth in a room through bodily chemicals and brain signals, and she puts forward the proposition that rhetorical scholars should account for how the body becomes stimulated to enter an affective trajectory that leads to positive or negative dispositions (p. 201). Similarly, John Lynch (2009) argues that a logic of representation in rhetoric "undermines a full examination of materiality and the complexity of scientific practice" and that a rhetorical theory invested in materiality must cease the "demonization of scientific materiality as the source of discriminatory attitudes and other detrimental effects" and should turn to the sciences through an analytic lens of articulation to understand how rhetoric acts

both out from the body and within the body (p. 435-436).[2] Taking the argument further, Diane Davis (2008) suggests that neuroscience findings give reason to completely undo or overturn existing rhetorical theory. In particular, Davis argues that Kenneth Burke's long-standing and highly influential theory of rhetorical identification should be reconsidered in view of Sigmund Freud's non-representationalist "primary identification" and in view of new neuroscience research into "mirror neurons," a group of neurons that seem to pre-consciously allow "direct access to the mind of others" by enacting a "direct simulation of the observed event" (Gallese, et al., 2004, p. 1).

However, the shift to a neuroscience of rhetoric or to the development of neuro-based rhetorical theory not only raises some pragmatic questions but also once again raises some of the epistemological questions that have traditionally divided the sciences from rhetoric. For one, does the integration of neuroscience in rhetorical theory-building require suppressing an acknowledgment of the rhetorical-ness of representations of data about the brain and neuroscientific language use in favor of treating empirical findings as objective, biological descriptions of human capacities? In other words, are the neurosciences recalibrating the relationship between rhetoric and "science," such that "at the heart of 'good theory' lies a prioritization of the biological constitution of being" (Papoulias & Callard, 2010, p. 31)? Although it is difficult to imagine that the movement to build theory from the neurosciences will reverse an intellectual culture back to a point where Rhetoric is once again merely "the title of a doctrine and practice" and no longer the "condition of our existence" (Bender &

[2] One assumes that Lynch's call for a new attitude toward the sciences will entail a close inspection and reanimation of the cognitive sciences.

Wellbery, 1990, p. 25), there still exists a tension between employing neuroscience findings as materially "real" and acknowledging that they are constituted by how they are expressed in discourse and, thus, dealing with the fact that they retain the potential for variability across multiple discursive performances. Alternately, there remains the question of whether or not the "turn to the neurosciences" (Johnson and Littlefield, 2011) means that neuroscientific findings must be viewed exclusively as modes of invention, not as declarations of/about human persuasion mechanisms, but, rather, merely as contemporary, contingent means for altering the direction of the ever-shifting "body" of rhetorical theory for some pragmatic purpose. Put differently: one wonders whether the rhetorical-ness of neuro-based rhetorical theory will ultimately have little alignment with the neuroscience's neuroscience.

Existing Research on Using Neuroscience in Non-Neuroscience Disciplines

These essentially epistemological questions require exploration and engagement. However, answering exactly how non-neuroscience fields like rhetoric are using and employing neuroscience findings remains largely unexplored up to this point. Only two studies, thus far, address the issue. The first study, by Papoulias and Callard (2010), examines how citations referencing two prominent neuroscientists and one psychologist are being used within critical cultural theory to ground claims about the power of "affect." Papoulias and Callard found poor contextualization and serious deviations in the cultural theory writings that reference the neuroscientific discussion about affect. The second study, by Jenell Johnson and Melissa Littlefield (2011), is built from a close reading of a few

trademark texts drawn from two new, self-proclaimed “neurodisciplines”: neuro-philosophy and neuro-sociology. The Johnson and Littlefield study concludes that the neuroscience research is treated as big-S Science itself and that epistemological priority is achieved by positioning the work of those new disciplines as “theory-building” or “fact-building” (p. 279).

Although quite fascinating, neither study explores the tie between 1) the perceived qualitative gaps separating neuroscientific and non-neuroscientific descriptions of the research and 2) the discursive moves made in the articles to accommodate the neuroscience research into existing discourse in those fields. The first study remains content to proclaim a difference between the depiction of neuroscience in the neurosciences as compared to other “bad” depictions, and Papoulias and Callard end that article with a somewhat vague challenge to the Humanities to do better interdisciplinary research, which amounts to asking scholars to read more neuroscience and to privilege the terms, frames and categories given by the neurosciences (2010, p. 50). The second study remains content to examine the large-scale rhetorical situatedness of some “neurodisciplines” in order to critique the way that neuroscience is understood in those disciplines *as* Science instead of a rhetorical process operating from negotiation and agreement, as numerous Humanities scholars have pointed out (Foucault, 1972; Knorr-Cetina, 1981; Latour, 1987). Both existing studies looking into the use of neuroscience in non-neuroscience disciplines, then, make claims about which discipline is preceding the other—the neurosciences first or rhetorical theory first—and are not discussing each discipline’s integration or process of co-development. In other words, these two existing studies on how the neurosciences are being used are not concerned with

the translation of neuroscience into those fields or with translation as a rhetorical process. Thus, these articles do not explore how the neuroscience terms like “mirror neurons,” “empathy,” and “affect” lace their way through the discourse even while they retain meanings in one field that have no relevance in the other and even while specific discursive strategies of making those terms “fit” into the lens of a disparate field to make the research palatable and meaningful have the potential to bring about confusions and divisions between the neuroscience’s neuroscience and the discipline’s neuroscience.

Actor-Network Theory and Translation as a Rhetorical Process

In response to the lack of research into the processes and outcomes of turning to neuroscience research and animating it in a persuasive way in “outside” fields, the central questions of this dissertation are: how do fields make the neuroscience research useful to them in order to build new theories or practices, and how are the neuroscience findings and the fields altered as a result? These questions are best answered by drawing on Science and Technology Studies’ discussion of actor-networks as explored in the work of Bruno Latour (1979, 1987, 1997, 2005), Michael Callon (1986, 1999), and John Law (1992, 1999). The notion of “translation” that they develop reveals how actor-networks are rhetorical and how Actor-Network Theory (ANT) not only has connections to rhetorical studies but can provide rhetorical scholars with an appropriate framework for studying the processes of interdisciplinary knowledge-making.

As Besel (2011) notes, there are many productive intersections between ANT and the

rhetoric of science. In fact, "ANT scholars borrowed from rhetorical theory to understand the internal workings of science," and Latour's (1997) establishment of ANT rests upon arguing that "scientists attempt to convince others that their particular theory is better than others' through the use of rhetoric, laboratories, and scientific 'black boxes'" or "technical artifacts" whose inner workings remain, sometimes purposefully, a mystery (p. 123). In fact, Latour (1987) has described ANT as following in the tradition of rhetoric (p. 30 & 97). Leah Ceccarelli (2001b) also notes the ties between ANT and rhetorical studies when she states that ANT scholars engage in a "close textual-intertextual analysis" in their work (p. 6). Indeed, ANT's approach to scientific processes is, in Besel's words, so "innovative" precisely because it centers rhetorical processes; ANT abandoned "all a priori assumptions about how science worked" and, instead, favored a view focused on the actual practices of science, seeing the defense of "good science" and "bad science," of "right theory" and "wrong theory" as dependent upon argument and material and discursive arrangements, which any rhetorical scholar would deem rhetorical processes of persuasion (p. 123-124). Besel (2011) even argues that seeing ANT as a rhetorical framework "builds additional bridges between Science and Technology scholars and rhetoricians" that lead both to a better understanding of scientific practice and that the ANT framework gives rhetoricians "another way to think" (p. 132).

But seeing ANT as a rhetorical framework means more than looking at the way scientists craft persuasive cases for their research, and this is where Besel, perhaps, does not go far enough in discussing why only a handful of rhetorical scholars turn to ANT (See: Besel, 2011; Graham, 2009; Kinsella, 1999). Adopting ANT means de-privileging human

rhetors in analyzing the processes of persuasion. It requires thinking about the ways that heterogeneous collections of humans and nonhumans network in certain circumstances to forge relations through discourse and material integrations and dependencies and, thereby, build “networks” through the establishment of those relations and then proceed to recruit additional “allies” into the “network” to strengthen it (Latour, 1997, p. 180). Thinking this way requires adopting the premise that “networks” do not “have well-established boundaries” (Callon and Law, 1997, p. 170), but are unstable and happen because all sorts of things in the world, people included, rely upon each other or must turn to each other in order to change or do work, thereby, congealing, if even for a moment, into what ANT describes as “networks” that can be mapped and analyzed as in-development. Another way of putting this might be to say that ANT argues that discourse, personal relationships, and technical materials and practices co-develop and that each has a role in forming things that become socially real—methodologies, theories, practices, etc. Thus, the rhetorical-ANT researcher should not necessarily assume that one actor has more agency than any other in the development of any particular network, and this stands opposed to much of the rhetorical tradition.

Privileging a rhetor crafting a message for a purpose and attributing any change to the symbolic forms constructed by the rhetor is a common practice in rhetorical studies. Joshua Gunn (2006) notes that the field remains largely human-centric to the extent that it adopts John-Paul Sartre's humanist existential philosophy, which suggests human beings are the primary and most valuable subjects of inquiry and that they construct their world through action. Gunn states, "The humanist orientation in rhetorical theory is reflected well in the

many discussions of the ethical responsibility of rhetorical choice-making, labeled by Kenneth Burke as 'symbolic action'… many of the notable 'turns' in rhetorical studies from the late 1960s onward are, sometimes unwittingly, built on the notion of a self-transparent rhetor/artist who makes rhetorical choices that entail a tremendous responsibility" (p. 80). Although rhetorical scholars such as Michelle Ballif (1998) have tried to move beyond this human-centric approach and have asserted the need to escape “illusionary” dichotomous logics such as active/passive, rhetor/audience to re-make rhetorical studies into something less “Modernist” and to try to take account of the role of nonhuman materiality in the processes of continual change (p. 64), the pathway to doing so, perhaps especially in the rhetorical tradition, is not entirely clear. In fact, ANT’s non-human-centric solution to studying the processes of change might be muddy for rhetoricians from the start since ANT did not originally develop as a rhetorical theory; it emerged from STS and sociology and, thus, remains riddled with specialty terms outside of the rhetorical vocabulary. Employing the language of “actors,” “networks,” “enrollment,” and “alliances” may seem odd or incompatible with a language focused traditionally on rhetors, audiences, appeals, claims, exigencies, and goals. Additionally, adopting ANT in rhetorical studies may have seemed and may still seem like an insult to textual studies since much ANT scholarship moves beyond an examination of text, going into laboratories. Somehow combining the work of a material rhetoric—such as that conducted by Carol Blair (2007) and Greg Dickinson (2002)—with a discursive rhetoric and then developing a cogent analysis as a result may seem difficult, unregulated, nontraditional or simply ambiguous.

Although the long history of rhetoric and the precise terminology it has developed

cannot and should not necessarily be immediately revised to accommodate ANT, the view that ANT, as a theoretical framework, insults textual studies or cannot be mobilized from texts alone is misguided. Indeed, ANT can be pursued through relying on an analysis of texts. There is nothing about the ANT approach that disallows looking at the way human and nonhuman actors are positioned by X author as grammatical actors in texts that, thereby, construct agency for those actors. This is partially because "agency," as rhetorical scholars have noted, is constructed (Herndl and Licona, 2007; Miller, 2007), and this construction can, and often does, take place in texts insofar as "agency" refers to how actors can make a difference through gaining "authoritative relations" (Graham, 2009) and, as a result, can be or must be "heeded" by a community (Johnson, 2009). Further, many STS scholars rely heavily, if not solely, upon texts to develop an ANT analysis (See: Besel, 2011, Law and Callon, 1992; Misa, 1992; Star and Griesmer, 1989), while others look to both texts and ethnographic observations in the field or the laboratory (Latour, 1986; Mol, 2002).

What ANT demands is simply attention to the non-human in the analysis. What receives the analysis in ANT is not the intentions or maneuvers of an author of a text, but how the actors are active because of their relations and how they require re-arrangement on the part of other actors. That an author does the work of writing the texts and arranging the actors is not denied, but if ANT is to be performed as a textual analysis and limited to text, then the text is to be viewed as an outcome of larger structural, material networks embedded in institutions and practices that are re-presented, re-arranged, and re-made "real" in and because of the text. Since the author's rhetorical choices are only accessible to analysis through watching the play of actors in the first place, the actors in the text are centered in the

analysis, and the author, although responding to a rhetorical exigence (Bitzer, 1968; Smith & Lybarger, 1996) and although retaining some agency in the writing of the text, is de-emphasized in ANT. This is because the author is an actor-network of pen, paper, appropriate writing practices, journal editors, citation requirements, professional relationships, methodological steps, technologically produced data, etc. The agency of the individual author in writing a text, in other words, is itself located inside of and emerging from within an actor-network that must negotiate actor-networks, of which the text becomes more like a trail of what has been left behind by the confluence of actor-networks colliding and combining.

Following this perspective, the ANT concept of "translation," specifically, can be taken as a useful rhetorical framework for studying texts because it describes the way in which "different claims, substances, or processes are equated with one another" (Callon and Law, 1982, p. 619) and details "the interpretation given by the fact-builders of their interests and that of the people [or things] they enroll" (Latour, 1997, p. 108). In fact, Dooreward and Bijsterveld (2001) describe translation in a way that resonates with rhetorical scholars when they call it "an ongoing process of meaning transformation" (p. 61). Smith et al. (2010) makes a similar statement: "The process of translation involves negotiations among human and non-human actors/actants which serves to define their interests and actions in the network" (p. 505). Callon (1986), who is credited with the fullest development of translation, states that translation is a general process "during which the identity of actors, the possibility of interaction and the margins of manoeuvre are negotiated and delimited" (p. 6). In other words, translation is, essentially, about rhetorical processes of constructing agency, defining who or what has support, and who or what can do work and continue to do work. From a

rhetorical perspective, the processes of translation can be studied in-person—through ethnography or through the observational practices of a material rhetoric—and/or through the textual traces of actors forging alliances and "defining their interests" across documents (Smith et al., 2010, p. 505). Choosing to examine texts and not take a broader observational approach is but a choice, and one about access and scope.

In terms of access, an ANT scholar doing historical work has the obvious limitation of having no access to an arena of action where human and non-human actors can be observed and mapped. Looking at the development of the light bulb industry in the 1920s, for instance, necessitates a shift to official records, but this does not mean the ANT perspective needs to be discarded. Likewise, an ANT analysis might not always benefit from direct observation. The case of this dissertation is a good example. Since the academic journal article is the primary site for finding and expressing the integrations and alliances in the process of doing cross-disciplinary research, making a comprehensive ethnographic analysis of several fields becomes unnecessary. Indeed, what seems most important in this case is that the neuroscience texts themselves are the primary actors enrolled by non-neuroscience fields while the texts also provide a bevy of scientific and technical actors for those "outside" fields to animate and enroll. So even though the academic journal article is the official, constructed record of actor movements happening within the neurosciences—presumably hiding material practices and scientific processes that went into its legitimizing formation—the other fields animating the neurosciences still turn primarily to these official texts. Operating from the assumption that human actors in non-neuroscience fields wanting to do cross-disciplinary work with the neurosciences do not themselves see stepping into a lab or speaking to

neuroscientists as integral to their own creations—an assumption confirmed by the disjointed and often poorly explained neuroscience findings in many non-neuroscience texts—there seems to be little reason to study this brand of cross-disciplinary work from the standpoint of ethnographic observation. In addition, ANT suggests that the agency of one actor—human or non-human—is just as meaningful as any other actor; thus, there is no reason to privilege ethnographic data. Rather, the work of analyzing how non-neuroscience fields make the neuroscience research "fit" into their existing actor-networks is most appropriately pursued trough textual-analysis.

Consequently, I turn in this dissertation to peer-reviewed journal articles as the primary and most important sites where fields explore neuroscience research and make it suitable to their work. Accordingly, I bracket all actors—human and nonhuman—as discursive constructions. In this way, I am able to highlight how human and nonhuman actors bridge divides between disciplines and make a difference to the development of a field of study. And I can do this while thinking about the role of machines and brains and citations and methods that hold their own social reality independent of any given specific human actor and require other (human or nonhuman) actors to heed them and, in that way, I can analyze how they "have agency" and contribute—not *just* human rhetors—to the processes of neuroscience being (re)made and (re)arranged to "fit" and do work in a non-neuroscience field. ANT actors, to explain the approach somewhat differently, have discursive manifestations in grammatical subjects and objects, which, as Gee (2005) notes, perform specific textual functions that offer insight into their relative roles (p. 25-26). Thus, locating at who or what is acting, who or what is enrolled as support for those actions, and who or

what does not act, offers an entry point into understanding how neuroscience is introduced into a non-neuroscience field and made influential within the production of academic texts. A rhetorical-translation analysis details a persuasion process where a network builds and re-makes itself through a series of discursive moves that ultimately craft convincing rhetorical alignments with actors from other networks.

Michael Callon (1986) defines these discursive moves as four "moments of translation" built from an analysis of actors, and his moments establish the specific rhetorical-translation framework guiding this study. His "moments" include: 1) problematization, or when actors define a problem in such a way as to make themselves indispensible to the negotiation of that problem, 2) interessement, or when actors seek to lock other actors into specific roles, 3) enrolment, or when actors define and interrelate the roles assigned, and 4) mobilization, or when actors use means to ensure the assigned roles are not betrayed by other actors, when "black-boxes" and new "facts" are created (p. 196). Dooreward and Bijsterveld (2001) refer to the first three moments as "congealment" of a network and the final moment as the "hegemonic power process" (p. 62-63).

Each of these moments is a point in time when actors act to, as Latour (1986) says, modify, deflect, betray, etc. in the creation of new knowledge (p. 267). As such, actors in documents like academic articles can be traced and understood through these moments of translation as they propose or arrange change—challenging an existing theory perhaps—and do so through defining a problem in reference to themselves or in reference to other human or nonhuman actors, through locking themselves or others into specific roles, through interrelating those roles, and through ensuring those roles cannot be betrayed by other actors.

In Callon's (1989) seminal article on the topic, he describes how scientific researchers defined the problem of why sea scallops would not reproduce in the shallows of a French bay; Callon shows how the researchers set themselves up as the only spokespeople for the problem, how they related the local fishermen to the uneducated class of "non-expert" and the scallop to the class of only speaking through particular forms of data measurement, and how the researchers then proceeded to protect these roles by continuing to enroll additional actors, including other scallops, other forms of measurement, others representations (of scallops' reproductive practices), and other humans. In the case that Callon explores, human researchers clearly did a lot of the work, but the analysis did not assume that they had priority in determining the outcome or the progression of events, and that is what an ANT approach offers that is quite unlike existing rhetorical or even social scientific approaches studying the processes of persuasion. Even though rhetorical scholar Leah Ceccarelli (2001a) recognizes "the recalcitrance of nature" and the way scientific texts are crafted in relation to scientific materiality and the laboratory, her concern is with how texts are made and how rhetorical scholars think about scientific texts; her focus is on the "constraints" of text production and the "connection between words and substance" (p. 317), not on the agency of things as part of a rhetorical analysis in such a way where humans might not be a central deciding factor in why humans ultimately appear persuaded or not. Callon, however, is concerned with non-humans in a more substantive way and, at least from the outset of his ANT analysis, finds no reason to consider the non-human's role in making a localized "world" anything but equal to the discourses of humans. In fact, in the end, Callon argues that the anchoring of the scallops on towlines convinced the fishermen to rebel against the role defined for them after they

initially looked to the researchers to define the problem and put forward solutions. Thus, Callon describes how nonhuman things have "agency" and need to be heeded—by actors in the play of the drama as well as by researchers analyzing that drama.

Consequently, this dissertation examines what happens when a central object of study—mirror neurons—are moved out into other disciplines and when other fields like robotics and dance therapy touch the brain sciences and researchers seek to define new problems, enroll additional actors, and develop new theories and practices. This is where ANT is rhetorical and where rhetorical criticism made operative through the ANT concept of translation proves insightful to understanding interdisciplinary epistemic processes happening through and because of all kinds of actors. Thus, this dissertation draws on the resources of the rhetoric of science (Ceccarelli, 2001b; Gross, 2002; Jack, 2010, Miller, 1992; Keranen, 2010; Prelli, 1989) and Actor-Network Theory (Latour, 1979, 1987, 2005; Callon, 1986; Law, 1992) in conjunction with the tools of verbal data analysis that allow for a mapping of grammatical actors across large sets of disciplinary texts (Fairclough, 2003; Geisler, 2004; Van Dijk, 2008; Gee 2005) to explore connections between the neuroscience research, the moments of translation, and the claims of various non-neuroscience disciplines. The goal will be to see what disciplines become and what neuroscience research becomes on the other end, so to speak, of translational processes. In even more specific terms, this dissertation analyzes how Robotics Engineering, Phenomenology, Group Analysis, and Movement Therapy have animated a set of cognitive neuroscience studies establishing the existence of "mirror neurons"—the most well-known and influential finding to come out of the cognitive neurosciences in the last two decades (Ramachandran, 2008; Stamenov &

Gallese, 2002). The study hopes to locate similarities and differences across these disciplinary translations and, in the process, learn about the actor-network dynamics involved in putting the neurosciences to use in non-neuroscience fields.

Accordingly, the second chapter of this dissertation discusses the history and neurological function of mirror neurons with the aim of familiarizing the reader with the concept and with the debates surrounding the meaning and quality of the empirical observations. The third chapter outlines this dissertation's methodology in detail, discussing how the disciplines and the texts were chosen and how the data analysis is organized from an ANT framework of translation that can aid a rhetorical-translation analysis. The fourth chapter summarizes the results of the verbal data analysis and locates patterns across all disciplines. The fifth chapter discusses how the verbal data analysis indicates each discipline's specific translational processes, and the chapter performs a close textual reading of specific, representative examples from each discipline, ultimately showing the varied uses and dynamism of the neuroscience research. The final chapter turns back to address the field of rhetoric and seeks to use the results of the previous chapters to provide a platform for thinking through the efficacy of a neuroscience of rhetoric; the prime goals of this final chapter will be 1) to develop suggestions for animating the neurosciences from a rhetorical perspective by identifying specific, key translational processes and 2) to outline what rhetorical scholars might be able to do with the neurosciences.

Understanding how another field's discursive strategies of translation conceal and reveal aspects of a neuroscience finding and enable that field to re-situate itself and produce results will allow for a critical, reflective interrogation of how rhetorical scholars might

themselves negotiate a "scientific view" ascribing "objective, permanent, and universal status to the facts produced by scientists" with and against a rhetorical view "marked by inter-subjectivity, transience, and situational delimitations" (Condit, 1996, p. 83). So this effort is not pursued simply to illuminate epistemological tensions; it is pursued to show how a scientific view and a rhetorical view are the same in that they are established rhetorically in discourse, and the effort is to show how rhetorical scholars can conceptualize and then engage the process of translating neuroscience while better accommodating a different, stubbornly material, basis of evidence. In the final chapter, I offer some recommendations to the field of rhetoric for neuroscientific engagement built from other fields' animations of neuroscience.

Re-Writing Rhetorical Theory from Mirror Neurons

Before moving on to chapter two, it is important to recognize rhetoric's pre-existing use of mirror neuron research in the work of Diane Davis (2008) and to discuss how her ideas inform the investigation pursued within this dissertation. Ultimately, an article like Davis' cannot be adequately explained away by an article like Papoulias and Callard's or by Johnson and Littlefield's. That is, Davis' incorporation of neuroscience research, meant to achieve the overturning of a long-held theory in the field of rhetoric, is not simply due to a failure to accurately interpret and apply the research, per Papoulias and Callard's conclusion, nor is it due to an insistence on seeing neuroscience as Science itself, per Johnson and Littlefield's conclusion. Davis' incorporation of mirror neuron research is, instead, a complex

rhetorical process of translation that manifests through several different discursive strategies. For this reason, Diane Davis' engagement with mirror neurons stands as an example of why an approach developed through the Actor-Network lens of "translation" is needed.

In fact, Davis' article offers some initial direction for thinking about what non-neuroscience disciplines may do when translating the neurosciences, and her work illuminates a tension between a push to enact a neuroscience of rhetoric and a need to acknowledge the rhetorical nature of the neurosciences. In addition, her article, entitled "Identification: Burke and Freud on who you are," makes significant theoretical shifts and, thus, serves as an example of the kind of impact the neurosciences can have on non-neuroscience disciplines. Thus, the article is pertinent to this dissertation, especially since it aims to rewrite rhetorical theory through a consideration of mirror neurons. Since this dissertation looks specifically at the ways mirror neuron research in the cognitive and affective neurosciences has been appropriated across four non-neuroscience fields for the purposes of understanding the importance and impact of "translation strategies" (Callon, 1986) on neuroscience and the general efficacy of using the neurosciences in rhetoric, it is only fitting to take a moment to consider how a well-respected rhetorical scholar such as Davis has approached mirror neurons and animated them to speak to her own disciplinary concerns.

This is done from the recognition that Davis is the author of this text but that her text operates through the actors she enrolls and the network of support she builds; thus, these actors and these networks do work because she is located within a larger actor-network that churns in a historical moment where these actors can do work and can be arranged such that

they are heeded; whether she wants them to do this or how she, as an individual rhetor, wants them to do this is not the concern. The concern is how the text remakes "the reality" of worlds by rearranging actors together such that Kenneth Burke's notion of identification can be called into question and revised. Seeing this process here, even if couched in human-centric language of "author" and "audience" for the time being, is intended to demonstrate points of connection between a more traditional rhetorical analysis and ANT as well as pave the way in later chapters for the structured data-analysis-infused investigation of translation processes across multiple texts in multiple fields of inquiry.

The Meaning of Affective Identification

Davis' argument begins by reclaiming a Freudian form of identification "always already" happening affectually within the body. Davis states, "Freud presents rhetorical studies with another, equally important task: to think the limits of reason by tracking the implications—for society, for politics, for ethics—of a radically generalized rhetoricity that precedes and exceeds symbolic intervention. It seems necessary today, at the very least, to begin exploring the sorts of rhetorical analyses that become possible only when identification is no longer presumed to be compensatory to division" (p. 144-145). Following from Freud's comment that it is, in fact, the failure of identification that forms social selves or, put differently, that alterity is born out of an "interruption of narcissistic appropriation" (p. 143), Davis seeks to make what Burke termed "identification" into an always existent physiological condition that the body itself "fails" to uphold in the conscious "withdrawal of

identity" (p. 144). Identification, then, is no longer compensatory to a necessary condition of division between people who are dependent upon "a rhetorician to proclaim their unity" (Burke, 1950, p. 22); identification is, instead, an underlying reality of the functioning of the human organism.

The belief that "Burke censored Freud" (p. 144) and that Freud got it right motivates Davis' turn toward the neurosciences and mirror neurons. Davis situates mirror neuron research as the scientific evidence that supports Freud's pre-rhetorical vision of the mutual, ecological and co-dependent condition of human existence prior to division. Davis states,

> who can deny that sense organs and sensory neurons, which operate together not so much at but as threshold, already indicate an excentric structure, an inside-outside similar to a Klein jar or möbius strip? Mirror neurons, which were discovered in the last decade of Burke's life, offer further confirmation… This means that the same mirror neurons fire in my brain whether I actually grab a pencil myself or I see you grab one, indicating no capacity to distinguish between my grasping hand and what is typically (and hastily) described as a visual representation of it: your grasping hand… a mimetic rapport precedes understanding, affection precedes projection. (p. 131)

By situating mirror neuron research as "further confirmation," Davis seeks to find additional evidence for Freudian insights that Burke purposefully "buried" (p. 125). That is, she turns to the neurosciences not so much to enact a "neuroscience of rhetoric" but to explain that the recent work in the cognitive neurosciences seems to confirm Freud's insights, and the rhetorical move that she makes by including this bit of scientific information—although interjected in a somewhat sudden and non-committal way—does a specific kind of rhetorical

work that deserves attention in a broader discussion about the role of the neurosciences in the future of rhetoric. In other words, since her audience is presumably rhetorical scholars, the neuroscience snippet she includes aims to convince rhetorical scholars through an appeal to the brain and positions neuroscience findings as an obvious resource for claims about "the truth" of rhetorical phenomena like identification. "Who can deny," as she says, the sense organs? Ultimately, the argument enables Davis to assert the following: "the entire logic of identification has to be rethought… it would necessarily precede the very distinction between self and other. Identification could not operate among self-enclosed organisms; it would have to belong to the realm of affectable-beings, infinitely open to the other's affection, inspiration, alteration" (p. 133).

From these passages, it is evident that mirror neuron research, for Davis, is one possible arena for rhetorically presenting a kind of un-rhetorical support for the concept of an ever-becoming human organism that develops in tandem with its surrounding environment; thereby, Davis is able to call into question rhetoric as the sole or primary force able to influence as well as constitute subjects at the origins of subjectivity. This desire to think of the human as firstly an organism "always already" identifying with the world is displayed in her choice of terminology. Referring to humans as "affectable-beings," situates what it means to be human as inseparable and coextensive with the felt-effect (or the underlying "affect") of a brain teeming with mirror neurons, which comprises the biological mechanism capable of producing, in Davis' view, an embodied identification *before* a "self" enters the world. The choice to use the word "affectable-beings" and to avoid the word "human," "person," or "body" reflects the basic ethical potential she sees in a wider recognition of the mutual

"exposure" of organisms shaping each other through an entwined process of Becoming (2010, p. 6). Put simply: for Davis, the unconscious "affectable" physiology of the human as evinced in some small part by the brain's capacity to "mirror" its environment works in concert with Freud's vision, ultimately suggesting that humans need re-conceptualization as most-essentially "affectable-beings" having no apriori division from one another.

Rhetoric and the Drive to Theorize Affect in the Humanities

What Davis develops is a bold revision of Burke—a well-timed and potent reversal on what has become a doxa of rhetoric. That is, Davis seeks to use Freud and the neurosciences to overturn "all that is considered true, or at least probable" (Amossy, 2002, p. 369) by most rhetorical scholars about the processes of human identification. Davis' efforts clearly participate in the on-going reconsideration of the relationship between rhetoric and science, in-line with work by Jenny Edbauer-Rice and John Lynch. But in so doing, she moves toward adopting the belief now circulating in critical cultural theory that "at the heart of 'good theory' lies a prioritization of the biological constitution of being" (Papoulias and Callard, 2010, p. 31).

Indeed, the article seems to impel anyone giving weight to symbolic representation in the construction of mental forms to abandon that position and try to account for it through biological processes. Because Davis is interested in a "primary identification" that uproots the "I" from representations and re-roots it in the functioning of an actor's brain, Davis resituates symbolic interaction as dependent on pre-existing biological movements; any view

of identification as forged out of a discussion of symbols will not offer the information about what identifying with an Other might *most basically* mean (p. 125); for that, a turn to the sciences may well be needed. Put another way: Davis turns to the neuroscientific lens because that lens does work that a rhetorical one cannot do when it only unpacks the scaffold of the constructedness of things. As will be further discussed, Davis seems to view the empirical observation as transcending its own condition of being as always already constituted and invested with the symbolic, and this position is held, albeit for her own rhetorical reasons, despite the fact that the empirical is only known *through* the negotiation of symbols.

What might be said here is that Davis' argument reveals a role for the sciences. It positions the sciences as existing, on some level, outside of the rhetorician's engagement with symbols. Science, it seems, holds access to a material world different from the one available to the rhetorician. Specifically, neuroscience is positioned as being able to more accurately explain human Nature since the tools and methodology allow neuroscience researchers access to the raw material functioning of the brain—the neuroscientific interpretations of brain functioning are imagined, at least for the sake of building new knowledge, as unmediated by representations so that they can explain more and explain differently than traditional humanistic or semiotic-based interpretations of human behavior. If Davis does not endow a certain privilege to science in this respect, then it is unlikely that she could assert what identification really *is*. For Davis, in other words, the scientific expression of the empirical observation receives no explicit treatment as itself rhetorical but is, instead, taken as a supra-linguistic observation.

Even so, it is likely that Davis recognizes the rhetorical-ness of the neurosciences. She is, after-all, a rhetorical scholar, and every inclusion, one can assume, is made for rhetorical reasons. In terms of putting the neurosciences to some use in her argument, she admits, "it's difficult not to read the published reports on the activity of mirror neurons and resonance mechanisms as eloquent deconstructions of Burke's ultimate order of things" (2010, p. 24). In fact, it is fairly obvious that she does "read" the mirror neuron evidence this way because, as she explains, she wants to support Levinas' assertion that a "preoriginary obligation" is what makes "passion," "pardon," and "proximity" possible among living entities. She finds ways, in other words, to convince her audience of a "preoriginary obligation" that always preexists the symbolic (p. 15). Her motive is to join the likeminded scholars named in the introduction to her 2010 book, many of whom privilege the rhetorical canon of invention following the active intellectual perspective carved out by Gilles Deleuze and Félix Guattari, suggesting an emphasis on material flows and new possibilities for life through embracing desire and force—not through critiquing discourse or argument or analytic philosophy—is intellectual work more "true" to ecological existence from the position of radical contingency (1994, 27-28 & 112-113); these scholars include Michelle Ballif, Jeffery Nealon, Victor Vitanza, among others, and like them, Davis aims to change what is "fundamentally rhetorical" by displacing the centrality of discourse in Rhetoric, even if it means, presumably, using the neurosciences a-rhetorically (p. 1).

Thus, in this article, Davis likely chooses not to address the way mirror neurons are social and symbolic for rhetorical reasons. If the article is to overturn Burke successfully, then Davis needs to assert that the sciences demonstrate a connection with others through

pre-conscious neuronal simulation, not through rhetoric. That's the point. And in this case, both affective and Burkian identification cannot be upheld as "true" since Davis asserts that Burke's notion of identification happening after a built-in division between bodies assumes a humuncular Self—although I later argue this may not be the case. Consequently, Burke is understood as too essentialist in his privileging of symbols and needs overturning. But more than this, Davis wants to claim that the neuroscience lends some reason to think that Freud's position can paint the better picture of identification, at least in terms of what identification *is*. In this way, prioritizing the biological over the rhetorical-ness of the construction of the neuroscience research serves the rhetorical function of overturning Burke.

This drive to re-theorize identification with a supporting appeal to the neurological indicates Davis' concern for materiality in rhetoric, and this trajectory cannot be conceptually divorced from the new desire to theorize "affect" in rhetoric and in the Humanities at large (See: Gregg & Seigworth, 2010; Hansen, 2006; Hawhee, 2009; Massumi, 2002). Davis' "neuroscience of rhetoric" participates in the on-going, pervasive attempts to adopt the sciences of the human body and to re-position rhetoric as not always dealing with the rational. Indeed, saying that the non-conscious biological processes of humans are able to make a difference to what human identification can mean for rhetorical scholars reveals the centrality of the body and, accordingly, the sciences of the body, to Davis' interests. Her work, in this way, follows from Jack Selzer's (1999) call to embrace materiality (p. 3), Hawhee's (2009) call for rhetorical scholars to take the movement of the body more seriously (p. 7-9), and Edbauer-Rice's (2008) call to theorize affect (p. 200).

In short, the argument Davis makes occupies a space now ripe for rhetorical

elevation; it carries the “seductive allure” of the neurosciences (Wiesberg et al., 2008, p. 470) over to the issue of identification, and in so doing, it makes a popular move toward affect and toward thinking about the non-symbolic, non-rational processes of the human after a highly publicized and quite impressive decade of cognitive science research pointing to non-conscious influences in everyday life (Appiah, 2010; Damasio, 1999; Robinson, 2005). However, despite the trendy trajectory, Davis’ theorizing does not deserve derision or rejection on the grounds that it participates in a focus on biological movements happening before or below the level of consciousness. In fact, it is difficult to say that she is not productive in this line of reasoning or that she is wrong-headed about the issue of identification. Moreover, the field of rhetoric does need to move beyond what Joshua Gunn (2006) described as its underlying “humanist philosophy” wherein rhetors are understood as rational creatures constructing their world through action (p. 77), and rhetorical scholars should start considering the affective productions of bodies as well as the agency of non-human actors. Conversely, though, the intellectual movement she makes does not deserve immediate and full acceptance on the grounds that it tries to theorize affect in rhetoric and uses a bit of neuroscience. With that said, her claims about identification are not the main issue here; it is the process she undertakes to make those claims, and it is how the claims that she makes are able to be made precisely because of her process.

In reference to her process: Davis’ article makes faint use of neuroscience citations, relying heavily on two sources, one from the cognitive neurosciences and one from

developmental psychology.[3] The article also never addresses the rhetorical nature of the neurosciences or mentions debates about the constitution, function, or potential multiple meanings of mirror neurons. Rather, the neuroscience, when used, is treated quickly as an obvious, objective, and universal side comment about the human. In short, Davis' article would benefit from a more complete recognition of the complexity and controversy surrounding neuroscientific findings into mirror neurons because it might have a direct bearing on her use of it as some evidence for Freud; she could better explicate for the audience how exactly her own revision of rhetorical theory is rhetorical, not only in the way it chooses a limited segment of the neuroscience research to enhance the power and universalizableness of a brain-based affective mechanism, but in how it employs the word identification in at least two different ways, obscuring what re-writing Burke might mean and displacing the necessary co-role of a non-rational disidentification. These are points worth noting and exploring in a bit more detail, particularly because they offer a jumping off point as well as a point of comparison for exploring other non-neuroscience disciplines' translation of this same neuroscience research. Ultimately, looking at multiple disciplines' translation processes of the same research finding offers Rhetoric's first engagement here several points of comparison and enables a conversation about translation as a larger rhetorical process.

The remaining sections of this chapter will explore Davis' use of mirror neuron research and of the terms identification and disidentification. The chapter concludes by indicating discursive features from Davis' article that can serve as a starting point for further

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[3] Although Davis cites Freud and Lacan, her only contemporary cognitive neuroscience source on mirror neurons is Rizzolatti et al, 2002, and she uses Meltzoff and Moore, 1977, 1983, 1989, 1994, 1997 from developmental psychology.

research into “translation” and how other non-neuroscience disciplines might engage the neurosciences in the same way when seeking to use findings to support old theories or develop new ones. In the final chapter, the dissertation returns to this discussion of Rhetoric and Davis’ engagement with mirror neurons in an effort to expand what she is trying to do and to further theorize a Neuroscience of Rhetoric for Rhetoric.

Selecting and Deflecting Mirror Neurons

Davis uses an appeal to mirror neuron systems as one rhetorical maneuver designed to overturn a Burkian “ontobiological divisiveness.” But a more complete overview of the neuroscientific research suggests that the physiological endowment as well as the capabilities of mirror neuron systems vary across human subjects. Much neuroscientific research has shown that mirror neuron systems—if they are “systems” at all—may or may not be responsible for the developmental mental structures of this or that person in respect to learning at different periods in an individual’s brain development. In short, mirror neurons may not be as prevalent or important for some people as for others (Dapretto et al., 2006; Oberman et al, 2005). Some researchers even question whether “mirror neurons” exist in humans at all (Turella et al., 2009). Consequently, Davis’ rooting of the self in the “other” through this research is somewhat problematic, at least insofar as she claims that human selfhood is initially engaged and continually developed through a neuronal “mirroring” of the world and, thus, that mirror neuron mechanisms retain some central significance for the material origins of the human self.

Although Davis' argument is strongly rooted in Freud's psychological theorizations, the part of her argument that turns to the contemporary neurosciences seems optimistic or ambitious when compared to the research on mirror neurons and the debate over their typology (Shapiro, 2009), function (Jacob, 2008; Welberg, 2008; 2010), and importance for theories of mind (Heyes, 2010; Hikcok, 2008). Put simply: Davis presents a singular view of mirror neurons and organizes the term—"mirror neurons"—for her own rhetorical purposes but does so in a way that elides the multiplicity of scientific views and possibilities for what mirror neurons might be or might mean for the analysis of human life. Consequently, it is unclear whether she seeks to make the research compatible with rhetoric by taking the scientific finding as "good-enough" of a construction to be incorporated into a rhetorical perspective or whether she simply wants to do more work in Rhetoric through the convenient coupling of the contemporary neurosciences with Freud. Nevertheless, it is clear that these standards for adoption of mirror neuron research, or any neuroscience research for that matter, would benefit from further scientific exploration, confirmation and elaboration.

Doubling Identification

Any limited deployment of neuroscientific research on mirror neurons can lead to a, perhaps unintentional, "neuro-essentialist" version of the Self that moves close to equating "subjectivity and personal identity to the brain" (Racine et al., 2005, p. 160). In privileging the mirror mechanism, what drops out is a discussion of the conscious, lived human experience, which remained so central to Burke's version of identification. To show how there are two different identifications being compared and discussed in Davis' article that

may not be completely at odds, it should be noted that Davis first argues that an acceptance of Burkian identification requires scholars "also to presume—as the condition for identification—a subject or ego who knows itself as and through its representations" (p. 127). And this is precisely why Burke's theory of identification becomes untenable for Davis—it does not reject ontological foundations and essential humanisms. However, this may not be the case.

For Davis to effectively argue that the self is not divided *first* but is, rather, a dynamic product of the environment wrapped up in an always-already identification, she appeals to both Freud and to the contemporary neurosciences; however, she ends up leaving phenomenal experiences of the body and conscious experience somewhat suspended and upholds a body-brain dichotomy by making the brain's automatic processes of environmental simulation the sole factor in thinking about what the Self *is* at its most basic. In short, Davis' prioritization of biological processes shifts Burke's sense of identification away from a thoroughly embodied and conscious engagement with rhetoric. She, rather, seeks to re-make "identification" into material processes—into the neurological coding of visual actions onto the motor cortex, a process described by Vittorio Gallese—one of the researchers who discovered mirror neurons—as "in no way obvious" and occurring below the level of consciousness (Stamenov and Gallese, 2002, p. 13).

Of course, asserting that identification is most primarily a non-rational, pre-conscious experience is exactly what Davis wants to do, so saying that she overlooks Burke's focus on encounters with the symbolic in an active social sphere might sound like an odd critique. However, Davis builds her argument on the assertion that Burke likely engaged in a

psychological suppression of Freud's insights (p. 141-142) even though it seems more likely that Burke intended to speak both to and within a realm of lived experience. In other words, it may be the case that Davis over-extends what affect should mean to Burke by assuming Burke's discussion of identification requires that he hold a view of the Self as an objective, ontologically primary Thing. Instead, Burke may have understood the body itself as the unit of division that determines an inevitable mental projection toward separateness. Put differently: in *The Rhetoric of Motives*, Burke (1950) speaks about social life in a way that suggests he held a view wherein each body and its mechanisms—being *already* physiologically divided from each other before the actions of those mechanisms could engage in whatever action (simulations or not) they engage in—form a division that stands as the beginning of a separated Selfhood that later becomes conscious and immediately embedded in the reflective position of asking "who am I?" And that question seems to be his prime concern when discussing the Self.

Burke's position on the primacy of a division of bodies becomes evident when the reader recognizes that a discussion of war, Hitler, and rival factions surround his famous passage on identification (p. 22-23). The emphasis is on conscious, lived experience and on active Self-formation in awareness; the body before that time may not be inhabited by a humuncular manifestation. From all indications, the Burkean conception of the Self *before* representation is likely nothing more than an entity with "uniqueness… in itself and by itself" (p. 21). The phrasing Burke uses here could just as likely point to the body's capacity to become uniquely itself and does not necessarily indicate a presumption about a preeminent, humuncular Self. In fact, it is telling that Burke maintains a clear interest in the human body

and its non-symbolic motions (Hawhee, 2010, p. 51-54, 83-85) but still considers "identification" to be a cultural effect independent of any claim about those motions. This is telling not because it reveals, as Davis assumes, his essentialist ontological position but because it reveals what he means when he says "identification."

Burke's strong emphasis on identification needing representation can be understood by considering his discussion of John Milton's poem about Samson, who "slew himself in slaying enemies of the Lord" (p. 19). Burke argues that killers are "'essentially identifiers'" (p. 20) and that Samson's destruction is a self-destruction insofar as his identity as "killer" is dependent upon the continued existence of those whom he kills. Despite this inherent recognition of an entwined identity here, Burke suggests that the presencing of others enables one's own condition, and it is through presencing or reference to another that identification, perhaps even a Self conception, is forged. Consequently, it is not surprising that immediately after this passage on Samson, Burke says, "A is not identical with his colleague, B," asserting that A must be persuaded to see their interests as joined (p. 20). Overall, then, it is clear that Burke thinks from the conscious condition of social bodies for theorizing identification, even as he recognizes the need for an Other to prop up an identifying Self. Therefore, it appears likely that non-conscious processes turning below a level of awareness simply would not persuade Burke that affective experience is a properly constitutive form of "identification" not already in its "identification" totally subsumed by the conscious experience of the division of bodies appearing before each other.

In brief, Davis' "identification" retains little similarity to Burke's rhetorical "identification" because of the way they both set out to define the term. And Davis' argument

does not necessarily undercut Burke's position on identification since her view does not show how exactly a conscious Burkean self-formation happening *after* symbolic experience is no longer significant to Selfhood in light of the discovery of an affective simulation in the brain. Her argument would need to show how affect wraps over or within Burke's concern with lived experience such that conscious experience of a skin-bound body is already an affectual identification that makes conscious division and symbolic play less important to the processes of identifying. In addition, she would need to directly address why the origins of a Self through an egoist disidentification would not support Burke's position over her own. In short, Davis seems to say something more or something in a different register than Burke. And seeing the difference exposes how terms like "identification" shift with their scaffold of appearance or, as Bruno Latour might say, reassemble with the enrollment of new actors and alliances that assemble terms; in this case, identification is reassembled through integrating Freud and current discussions of affect and neuroscience, which distances the relevance Burke assigned to conscious division as something, perhaps, looping back over (and within) an "affect" that is, in Davis' terms, said to "always already" precede it. But from Burke's position, the affective mechanism, it seems clear enough, can never again precede the conscious experience; consciousness influences or loops into the "always already-ness" of the felt affect and responds to the appearance of bodies who are "always already" out there in the world but may not be able to "always already" present that way in the body. Whatever the case, there is a distinct sense of running around in circles between the two meanings of identification that seem more complementary than competitive.

The Role of Division and Non-Rational Disidentification

Cognitive neuroscientist and philosopher Humberto Maturana (1980) has pointed out how biology and the conscious experience of that biology are mutually co-developmental (p. 28). Following his insights and the general trajectory of an analytic dedicated to ecological relations, it would appear difficult to assert the view that affect's own movements are existing independently of what we would call conscious awareness and that the two do not structure, inform, appear parallel or reshape each other in a complex feedback loop. The point is: Davis' argument for the shape of affect may benefit from seeing some dependence on Burke's focus on rhetoric, and equally so, Burke's focus on rhetoric may benefit from seeing how it moves out of Davis' argument about affective response to the Other as the underlying response that is what he calls rhetoric.

Nevertheless, Burke may still well argue that he needs Davis' argument less than she needs his because the conscious experience of a body divided from other bodies does not lead to the feeling of one-ness as much as the feeling of division—unless rhetoric is involved. Judging from *The Rhetoric of Motives*, the importance of non-rational identification in human experience would probably, in Burke's view, be so overwhelmed by conscious experience of the isolated-ness of the body that any affective movements organized as identifying ones would quickly fall in need of language. This is, arguably, why many scholars interested in affect turn to the infant to study it—the infant is "a space seemingly cleansed of the complicating and duplicitous patterns of language" (Papoulias and Callard, 2010, p. 43). As a result, affect theory can operate "at a distance from the axis of perception-cognition-symbolization" (p. 44). And this need on the part of Humanistic fields to speak

about human life before or outside of conscious experience is satisfied in the neurosciences, which retains a veil of freedom from symbolization and its effects.

But even if the neurosciences are recognized as a symbolic enterprise and Freud is still upheld in favor of Burke, arguing for affective identification as central to human organisms may remain difficult without lending the same prominence to the disassociation that the Self must produce to distinguish itself from other Selves. In other words, there is a theoretical problem that needs resolving. One wonders how identification can be a pre-rational, physiological process in the brain that "always already" happens prior to disassociation while the act of disassociation that *is* the move that makes the Self appear can appear if nothing but association pre-exists the dissassociative move. Disassociation is defined as the failure of a brain to maintain identification, forming the Self (p. 143); the theoretical difficulty, however, arises when an identifying-being built from identifications fails to identify. If the disidentifying being comes into existence exclusively out of an organism that is nothing in its mind but the immanence of mimetic processes, then a suddenly appearing disidentification could be seen as equivalent to a black spot appearing on a white sheet of paper with no existence of ink, unless, of course, the disidentification was also a pre-conscious physiological process "always already" capable and contingent on identification. A Self cannot preexist disidentification and then choose to rationally enter into existence. Of course, the disidentification could be forced on by the experience of birth and sociality, as David reads Freud (Davis, 2010, p. 35), but where and how the affective identification precedes ego development raises questions about how affective identification works significantly before Burkean awareness of bodies divided from each other.

The lack of attention to a non-rational biological component of disidentification is evident as Davis articulates the production of the divided self this way: “it is through disidentification, dislocation, depropriation that social feeling emerges and (so) something like society becomes possible” (p. 144). The word “emerges” negotiates the problem through ambiguity and holds the emphasis on identification. Saying that any disidentification is simply an interrupted “narcissistic appropriation” (p. 144) that is a “failure” and “the withdrawal of identity” keeps the issue unresolved (p. 144). Of course, there may be another neurobiological explanation for disidentification to which Davis can appeal, but the stressed importance or priority of identification is worth considering when identification seems a worthless concept without the immediate disidentification that can give rise to a Self that can, then, be said to be identifying. So it is also worth considering whether anyone can successfully revise Burke by saying human physiology is wired for an affective identification if, in fact, this kind of identification happens because of a disidentification that must also always occur.

Predicting Patterns Across the Disciplines

These difficulties in Davis’ argument may find resolution in her future work. Even so, they can be treated as predictive of what other rhetoric articles might do when using the neurosciences as evidence for a new theoretical position, and further, they may be predictive of what other non-neuroscience articles will do when seeking to revise their own theory through appeals to the neurosciences. In fact, if Johnson and Littlefield’s article is taken into

consideration at this moment, then their finding—that multiple fields using the neurosciences all appear to treat the neurosciences as Science itself—it would be reasonable to suggest that multiple fields will show other recurring patterns in other areas as well, perhaps positioning neuroscience research similarly to Davis. In short, Davis' article demonstrates a need for looking more closely and more carefully at translation as rhetorical activity.

The following observations from Davis' article serve as a starting point for such work:

- neuroscience research is treated as objective, and it is not acknowledged as rhetorical;
- neuroscience research is treated as stable, and disagreements in the neuroscience community are not acknowledged;
- neuroscience research is treated in such a way that the brain acts independently of the body and the environment, and a "neuro-essentialism" results;
- neuroscience research is positioned as the spokesperson for Nature and operates as an explanatory mechanism for questions about human activity;
- neuroscience research is compared or situated in reference to a source more familiar to the main audience (in this case, Sigmund Freud), and that source mediates the neuroscience, making it suitable for discussion in the new disciplinary domain;
- potential disruptions, such as the role of disidentification in identification, are suppressed
- theoretical terms become vague or take on multiple meanings when the

neuroscience is used in an effort to revise the meaning of an existing term in the field.

These findings serve as a starting point for an investigation of multiple articles animating neuroscience research within four different academic fields: robotics engineering, group analysis, phenomenology, and movement therapy. Ultimately, these findings prove suggestive toward strategies of translation in that they offer hints at how neuroscience research itself becomes a powerful actor and how other, more familiar, actors are enrolled as support to protect the newly assembled actor-network against challenges. These observations have productive intersections with existing ideas about translation as delineated by Actor-Network theorists. Before detailing how those ideas inform the methodology used to complete this study, understanding the history and controversy surrounding mirror neurons from a neuroscientific perspective can enable a complete, in-depth evaluation of the ways that other non-neuroscience fields have animated that work and engaged in some of the same selections and deflections witnessed in Davis' article.

CHAPTER 2:

MIRROR NEURONS: HOW DEFINITION, HISTORY, AND CONTROVERSY ENABLE CROSS-DISCIPLINARY UPTAKE

Mirror neurons are big news, touted as "shaking up numerous scientific disciplines, shifting the understanding of culture, empathy, philosophy, language, autism, and psychotherapy" (Blakeslee, 2006, p. 2). In the words of some of the founding neuroscientific researchers, "it is hard to overestimate the importance of this discovery" (Stamenov and Gallese, 2002, p. 2). Indeed, mirror neurons have been invoked for their potential to significantly change traditional understandings of imitation, social intelligence, and emotional processing. Thus far, they have been used to explain how animals and humans can imitate movements even when those movements have never before been executed (Fogassi et al., 1998, 2005; Gallese et al., 2001; Umiltà et al., 2001). They have been used to explain how humans can predict other people's future actions (Goldman, 2006). They have been used to explain how emotions can bubble up inside of a person when he/she views the face of another person experiencing an emotional event (Damasio, 2003; Wicker et al., 2003). They have also been used to explain the development of complex memory systems in humans (Gruber, 2002, p. 77).

This chapter explores the multiple meanings of mirror neurons by examining their definition, exploring their history in neuroscience research, outlining their potential implications, and considering the scientific controversies surrounding the associated findings. Ultimately, the aim of the chapter is to argue that shifting conceptualizations of mirror

neurons and competing interpretations about their existence, function and importance open up the possibility of diverse animations across the disciplines. As a result of mirror neurons being used in a myriad of explanatory ways for field-specific problems inside and outside the neurosciences, numerous citations are available to provide convenient points of connection for all kinds of research interests. In this way, the neuroscience is open to be "translated" into other fields, or as Bruno Latour might say, it is easily reassembled through constructing a new network of neuroscientific, citational, technological, and regional actors.

The specifics of those translation processes in each field are detailed in the next chapter; this chapter simply provides a careful overview of mirror neuron development from the neuroscientific literature in order to aid an analysis of re-animations of the literature across journal articles in other fields. In this way, this chapter offers a point from which to consider the multiple interpretations of mirror neurons and the importance of associations and disassociations with the body of research as it is made compatible with the concerns of non-neuroscience disciplines.

Understanding which interpretations are adopted as well as which controversies are ignored and which are brought to the surface support a rhetorical analysis of animations of this neuroscience research. But, perhaps, more to the point for this chapter, the controversy surrounding mirror neurons and the finding's wide application as an explanatory mechanism for everything from the origins of empathy to the ability to imitate others allows for many curious intersections and interpretations.

Defining Mirror Neurons

So what are mirror neurons? As Anne Marie Mol (2002) has noted, explaining what some thing *is* can be difficult to do since "objects come into being—and disappear—with the practices in which they are manipulated" (p. 5). The common explanation, however, offered by the original researchers is that mirror neurons are a type of visuomotor neuron, which activate both when a person sees an action and when a person does that same action (Gallese & Goldman, 1998). In other words, mirror neurons are defined both by what they appear to do—activate in certain circumstances (Di Pellegrino, et al. 1992; Rizzolatti et al., 1996)—and by the connections that they appear to maintain in the brain—most commonly between the visual system and the motor system (Gallese, 2006; Press et al., 2011; Turella et al, 2009). Although similar mirror-like neurons may exist in other areas of the brain (Kohler et al., 2002; Raos et al., 2004), mirror neurons have been most extensively studied within the F5 area of the brain, also called Broca's area (Di Pellegrino, et al. 1992; Rizzolatti & Sinigaglia, 2008). In short, mirror neurons are quite unusual since typical or "canonical neurons"[4] located in the motor cortex activate only when an action is performed, not when a person sees an action; thus, mirror neurons are said to "mirror" the sensed environment or to "simulate" that visual environment in the motor area. What exactly mirror neurons are doing and what they mean for the constitution of one's understanding of the world, however, has been the subject of much research and debate.

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[4] The term "canonical neuron" refers specifically to motor neurons that only active when motion is performed, not when seen.

Initial Discovery of Mirror Neurons and a Revised Theory of the Motor System

Mirror neurons were first discovered in macaque monkeys. Di Pellegrino, et al. (1992) found that the same part of the monkey's brain would activate when it completed an action as when it watched a human complete that same action. Consequently, mirror neurons were proposed to enable "a direct simulation of observed events" (Gallese et al., 2004, p. 1) on the micro scale through individual neurons. This observation opposed traditional theories about the motor system of the brain.

Past views held that the motor system was "a passive executor of commands originating elsewhere" (Rizzolatti and Singaglia, 2008, p. 19). This meant that the motor system was not understood as intimately integrated with the sensory system. The narrative at the time was as follows: "when we pick up an object with our hands the brain implements a number of serially organized processes, sending information that arrives from the sensory areas to the associative areas for integration, and then transmitting the resulting data to the motor cortex to activate the appropriate movements" (p. 3). This theory no longer holds. Studies with mirror neurons have established ties between sensations—such as seeing the shape of a coffee cup—and the motor movements of a hand that can grasp the cup (p. 3-20). Fogassi and Gallese (2002) theorize that internal "representations" are made and maintained so that we can "accomplish a variety of tasks such as writing, typing, modeling" (p. 14).

However, what proved interesting about the discovery of these unique F5 visuomotor "mirror" neurons was that they activated in exactly the same way, whether a monkey was

grasping the cup or merely watching someone grasp a cup[5]; in one instance the monkey was moving, and in the other instance, it was not. The answer as to why the neuron patterns looked identical but did not result in identical behavior was that other parts of the brain needed to be enrolled for action execution (Rizzolatti and Singaglia 2008, p. 48). This explanation still stands and established all motor movements as reliant upon a complex system spread across several brain areas. But more importantly, perhaps, mirror neurons were interpreted as being about possibilities. Put differently, they were understood as "a call to arms" or a representative primer for certain actions that, in neuronal patterns, "categorize objects in terms of possible actions" (p. 49). Consequently, subsequent mirror neuron research focused largely on what exactly "a call to arms" in the brain might mean for perception.

Implications Following the Development of Mirror Neuron Research

Perception and Understanding

By the mid-1990s, it became clear that F5 motor neurons were considered to be a link between hand and eye. Mirror neuron research, for example, seemed to establish that the eye saw what the hand could grasp but that the hand was, in turn, equally involved in the act of seeing since what was seen was, in terms of object-understanding, that which held the

[5] Mirror neurons can appear both "strictly congruent" and "broadly congruent." Strict congruence means they fire in exactly the same way when the subjects sees as when the subject performs the action. Broadly congruent means the firing is very similar. The differences in exactness are theorized as representing "different levels of generality." See Rizzolatti and Singaglia, p. 82.

capability to be grasped in this way or that way. “In other words, these [mirror] neurons appear to respond to the meaning the stimulus conveys to the individual, rather than its sensory aspect, and ‘reacting to a meaning’ is precisely what one means by *understanding*” (Rizzolatti and Singaglia, 2008, p. 50). Here, the notion of “understanding” meant realizing what could be done with classes of objects sensed in the environment. Mirror neurons were not implicated in saying anything about semantic assignments in terms of “understanding” a cup as a cup—that was/is believed to involve other integrations of additional perceptions like colors, textures, etc.—but, instead, they imbued perception with visuomotor “understanding” about “something that can be picked up by hand” (p. 51). In that way, and on that level, mirror neurons were marked as inherently producers of meaning. In short, mirror neurons made visual perception more than a signal about the sensed environment; visual perception was now meaningful from within its construction through its inherent tie to motor responses.

Imitation

Since mirror neurons were interpreted as “a direct simulation of observed events” (Gallese et al. 2004, p. 1), they were then theorized as an explanation for imitation, “action-understanding,” and identification.

First, with regard to the notion of imitation: the idea that mirror neurons formed the basis for imitative behavior was, in the first place, supported by a specific theorization of what “direct simulation” meant. In a series of papers, neuroscientist Marc Jeannerod (1995) and Jean Decety (1995) suggested that mirror neurons functioned to craft internal “motor schemas” that “simulated” observed events under a “direct-matching” hypothesis (Jeannerod,

1994, p. 187). The idea was simply that watching another individual do a never-before-seen action—such as a conductor directing an orchestra in a new way—prepared the viewer to repeat that action, to imitate it. Thus, mirror neurons became a basis for understanding how imitation was possible—through neuron firings that were, through those firings, constructing a neuronal representation already tied to motor movements.

Craighero et al., (2002) concretized that conclusion in a study that asked participants to hold one hand over a metal bar and perform the action of grabbing the bar as fast as possible upon viewing a picture. In cases when participants saw a picture of a hand grabbing the bar in the opposite way from that which their hand had been positioned, they hesitated. The study, thereby, offered evidence for correlating visual processing of the picture with the resulting motor action and suggested that the processing of the picture was influenced by the pre-prepared motor action. Put in reverse terms, the pre-prepared motor action encountered interference with a visual perception that was inherently tied to motor responses such that participants had to negotiate which way to move their hand. These studies taken together, among others such as Fogassi et al., 1996, suggested that mirror neurons enabled motor schemas or "representations" of motor movements from vision, which ultimately facilitated the ability to imitate.

Action-Understanding

But more than this, studies by Umiltà et al. (2001) and Kohler et al. (2002) found that F5 visuomotor neurons fired whether or not a monkey saw an object involved in a goal-related action. In other words, mirror neurons did not fire when objects were merely seen

(Rizzolatti et al., 1996); instead, mirror neuron firing "was locked to the action, not the presentation of the object. This temporal correlation indicates that all responsive neurons coded the action made by the experimenter, albeit hidden, and not the object" (Umiltà et al., 2001, p. 160). As a result of this study, the focus of mirror neuron research became less concerned with objects proper; indeed, the implication was, essentially, "when visual cues are limited, the activation of mirror neurons can place the observer in the same internal state as when actively executing the action" (p. 161). Thus, mirror neurons were said to "underpin action-understanding" (p. 160), a type of understanding that goes beyond merely knowing that something could be "picked up by hand" in this way or that way (Rizzolatti and Singaglia, 2008, p. 51).

Thus, the function of mirror neurons was clarified insofar as they were shown not to represent object structures but motor movement structures and to do so primarily in relation to outcomes, when certain movements resulted in certain goals. Mirror neurons were, in short, taken as the biological basis for conceptualizing what goal was being enacted, what was wanted, and what might need to be done. In that sense, then, the term "action-understanding" meant brain recognition of a goal immediately known from and *through* movement and facilitated a theory that mirror neurons also underpinned the ability to guess what people would do and could explain how individuals "read" other people's minds (Gallese, 2007; Jellema et al., 2000; 2003). This shifted the interpretation away from the primarily imitative function, as hypothesized by Jeannerod, to a goal-detection function that itself might allow for imitation.

The Umiltà et al. (2001) study validated the idea that an action can be re-created in terms of its goal. Put differently: F5 visuomotor neurons crafted motor schemas from the "understanding" of a goal-directed action even when that action was not totally seen. Consequently, mirror neurons were said to no longer *only* explain imitation by appealing to a link between visual processing and the motor cortex; they now *also* provided a basis for a back-and-forth process between prediction of another person's future actions and motor movements such that the way one moved visually said something about one's goal, and one's goal said something about how one will, could, and might then, himself/herself, move. Although Rizzolatti and Singaglia (2010) argue that there are different levels of understanding the reasons for an action and that a "mentalizing network" (de Lange et al., 2008) also needs to be enrolled for a subject to guess the intention of an action, the mirror mechanism in motor areas, nevertheless, became crucial, in their view, to "allowing the understanding of actions of others" from the inside by linking the observation to one's own bodily experiences and production (p. 454). Already at this point, on the most basic level of the perception of movement, mirror neurons are open to multiple framings. The neuroscientific literature, in other words, enables multiple entry points for thinking about mirror neurons. For example, if citing some of the founding studies in the 1990s by Gallese and Rizzolatti, a researcher might discuss mirror neurons as a "direct simulation of observed events" (Gallese et al., 2004, p. 1). This way of thinking about them offers, as an option, the logic of the mirror already advanced in the mirror metaphor imbued in the term "mirror neurons"—the biological entity can be understood as a mediated reflection that overcomes or eliminates the representational nature of its own mediating means; mirror neurons under the

mirror metaphor might, in short, enable pure access to the outside Thing itself, giving humans access to the Other in an un-obfuscated or un-distorted way through a meditation that is said to build a "direct" representation. The promise here, as Michelle Gibbons (2007) says of brain images, is "access to a person's most private recesses" wherein one can seemingly move beyond mediation. This direct mirror-based interpretation of mirror neurons, if one choose to pursue it, could also appeal to a scientific practice that, in the words of Celeste Condit (1996), seeks after "objective, permanent, and universal status" (p. 83) insofar as the mirror neurons activate underneath or before rational cognition and prove in an elegant and simplistic way—through the mirror metaphor—how complex imitative mechanisms work; the mechanism, essentially, roots the origins of cognition beyond the subjective nature of representation and in a materiality that can be said to be objective and universalizable.

Alternatively, citing later work by Umiltà et al. (2001) might result in the disabling of the mirror metaphor and lessening the explanatory power of mirror neurons, limiting any interpretation to specific kinds of goal-directed actions. The promise there might reside in celebrating the complexity of human perception or in arguing that the brain, by detecting only movements that have goals important to survival, has adapted as a protection mechanism, not as a mechanism of "good reasoning." Calling attention to the Umiltà et al. study might serve, then, to emphasize the importance of patterned movements in producing biological means capable of predicting important personal and social effects. This view of mirror neurons as a survival mechanism operating out of the reason-less evolutionary framework that, nevertheless, evolves for a good reason, has also been advanced in the

relevant research (See: Corballis, 2010; Rizzolatti & Craighero, 2004), providing an alternative framework for discussion about mirror neurons and their role in human life.

Whatever the interpretation one chooses, considering Goffman's (1974) work on "frame analysis" and Todd Gitlin's (1980) definition of framing as rehearsed patterns of "selection, emphasis, and exclusion," the frame that a thinker/writer chooses ultimately affects the associations that can be made. If a researcher chooses citations that frame mirror neurons as a mechanism of mirroring understood through the mirror metaphor, then mirror neurons have certain behavioral effects and move into the "biosocial" realm in a particular way. In Davi Johnson's (2008) terminology, the "biosocial" names a discursive realm where biological information is "a means of communicating personal worth, social value and political order" (p. 148). It names a state wherein saying someone is "cingulate" means that they are stubborn and unwilling to compromise (p. 148-150). Thus, if mirror neurons operate "biosocially," then the logic of the mirror might directly equate mirror neuron functioning to human intelligence, quick learning, and intuitive capacities; if operating poorly, then the person who appears slow and unable to discern motives might be understood as deficient in mirror neurons. Mirror neurons, in brief, become symbolic for social orders in different ways and are enabled by different frames.

The point of this brief discussion is simply to suggest that the shifting research on mirror neurons and the lines of connection that it can make to other areas of research produces multiple possibilities and enable different social meanings and power relations, which will surface in later discussions. Yet, what has been explored thus far about mirror neurons and their variability and possibilities is just the beginning of the story.

Identification

Mirror neurons have been interpreted as central not only to understanding the goals of others, but also to emotional states. Saying mirror neurons constructed "action-understanding" implicated them in the processes of forging interpersonal human identification. If mirror neurons fired whether one wanted them to fire or not, and if they placed "the observer in the same internal state" as the individual being viewed (Umiltà et al., 2001, p. 160), then the question was when this happened and whether there was anything that could appropriately be called "identification" happening. Any answer would, of course, be dependent on how one defined "identification." Still, a study conducted by Buccino et al. (2004) was able to shed some light on the question from a neuroscientific perspective.

Buccino et al. (2004) established that a human watching another human eating food activated the same mirror neuron areas in the inferior frontal gyrus (Broca's area) as a human watching a dog eating and as a human watching a monkey eating. However, the same study showed weak correlation between a human moving her/his lips and a monkey moving its lips and absolutely no correlation at all when a dog was shown barking (p. 115). These results were informative to the concept of identification because they suggested the neuronal representation was not altered by obvious (species category) differences. Equally, the results did not, as Rizzolatti and Singaglia (2008) noted, suggest that humans did not understand that the dog was barking or what barking meant in a general sense (p. 135). Instead, the results were interpreted by Buccino et al. as once again showing a tie between mirror neurons and goal-related actions (p. 115-116). That is to say, they were interpreted as limiting mirror neurons to the role of "mirroring" specific types of movements, not the whole environment in

the visual field. In this way, the findings correlated mirror neurons with a level of comprehension—about what, exactly, the goal of barking was, for instance—as well as helped explain how "mirroring" relates to "understanding" others and "identifying" with facial behaviors. That is, mirroring happens when movements have a discernable goal or outcome that can be assumed from repeated engagement with those movements.

In summary, the notion of identification as filtered through this admittedly reductionist neuro-biological perspective was dependent upon a scaffold of factors, which amounted to what Umiltà et al. (2001) originally called "taking the place of the observer." In other words, many mirror neuron researchers preliminarily supported the view that individuals do, below the level of conscious awareness, "identify" with others in the sense that mirror neurons respond to movements engaged for what are understood as goal-directed actions that allow individuals to predict future actions by "simulating" the "meaning" of those movements. However, not knowing the goal of the dog's barking—to take one example—would limit mirror neuron firing and also, perhaps, call into question even this extremely narrow sense of neuronal "identification" from mirror neuron studies. In brief, mirror neurons were re-oriented as awareness-producers from within a limited scale of goal-directed actions.

Yet, the notion of "identification" should not herein be conflated with the notion of action-understanding. Identification in its colloquial sense entails emotional response in relation to another being wherein one being takes the mental place of the other, not simply a neuronal representation of another's goal-directed action in the brain. Yet, even on this more complex emotional level, mirror neurons have, too, been theorized.

Emotions

It is both unfair and unrealistic to suggest that emotions do not play a role in everyday movements or that an affective response to the world does not inform perception. As Jenefer Robinson (2005) notes, “there is good evidence that our earliest emotions or affects do not require complex cognition” (p. 37). Richard Lazarus (1982) argues that there are no purely rational perceptions devoid of an awareness of one’s own interests, which is, as Robert Solomon (1988) and Robinson (2005) have noted, a necessary precondition to the existence of emotions in the first place. Rizzolatti and Singaglia (2008) put it this way: “Things are hardly ever just within reach or out of reach, graspable or not graspable, graspable with the hand or mouth, with this grip or that grip: they almost always incorporate a threat or an opportunity, they are repulsive or attractive, provoke fear or wonder, disgust or interest, plain or pleasure, and so on” (p. 173). Consequently, neuroscientists have examined the potential for mirror neuron action in parts of the brain associated with emotions. The guiding assumption rested on the view that mirror neurons of some type—perhaps the ones in the F5 visuomotor area or perhaps in other areas as well—would be detectable since visual perceptions were networked with mirror neurons. In other words, if visual perceptions primed the motor cortex for action and crafted a schema of the actions being seen, then neuroscientists could expect the same to hold true for emotional areas of the brain activated by visual perceptions (p. 179-181).

Even before the discovery of mirror neurons, researchers had reason to believe emotional areas of the brain had important ties to visual perceptions. On the most basic level of embodied experience, interacting with others, even watching a film, could generate

powerful emotional responses. In the realm of neuroscientific research, Plailly et al. (2007) showed that the insula—a small nodule tucked deep in the center of the brain—activated with taste and smell, and Krolak-Salmon et al. (2003) showed that the insula activated in monkeys and in humans when the subject felt nauseated. When these observations were coupled with additional studies by Philips et al. (1997, 1998), which previously showed that pictures of disgust on the faces of people could activate the insula, the rationale for theorizing an emotional "mirror" mechanism was in place. Indeed, the initial hypothesis of a mirror mechanism seemed confirmed when Adolphs et al. (1998) completed a study on an individual with serious lesions in the insula who could no longer feel disgust or sense disgust on the faces of others. Consequently, disgust was theorized to be not so much a rational activity "based on inferential or associative cognitive processes" (Rizzolatti and Singaglia, 2008, p. 182) but was better explained as a process of simulating or "mirroring" the environment in terms of what a viewing body was coding—or had already experienced—as disgust.

This was also the conclusion offered by Wicker et al. (2003) when they set out to look for mirror neurons in the anterior part of the left side of the insula. Using fMRI technology, they asked a set of participants to smell disgusting odors in addition to watching videos of people smelling different odors, including disgusting ones. They found that the anterior insula activated—meaning it "lit up" on the fMRI scanner—both when smelling disgusting odors and when watching others smell disgusting odors. Like mirror neurons in the F5 area that suggested there was the same neural base for vision and motor actions,

specific neurons in the insula also seemed to demonstrate a shared neural base for vision and emotional response, at least in terms of disgust.

However, it should be noted that mirroring the facial responses of others in the insula does not necessarily equate to emotional response. Activation of brain areas assigned to emotions does not always translate into a subjective feeling of emotions. As Damasio (2003) notes, "The presumed mechanism for producing this sort of feeling is a variety of what I have called the 'as-if-body-loop' mechanism … neurons can represent in individual's brain, the movement that very brain sees in another individual, and produce signals toward sensorimotor structures so that corresponding movements are either 'previewed,' in simulation mode, or actually executed" (p. 115-116). What Damasio references here—although claiming it with his own self-assigned language—is what Umiltà et al. two years earlier had previously called placing "the observer in the same internal state" (p. 160). This "as-if" representation and neural preparation—not full and exact reproduction—seems to be the likely function of mirror neurons. Rizzolatti and Singaglia (2008) make the point and, perhaps, also deflate some of the potential power of mirror neurons to craft "identification" with others when they say, "we do not need to reproduce the behavior of others in full detail in order to understand its emotive meaning, just as action-understanding does not require the actions to be replicated… this mirror mechanism is not the only way our brain has of understanding the acts and intentions of others and this is true also for emotions" (p. 190). In other words, "understanding" emotions is, at this point, not fully dependent on mirror neurons. "Identifying" with others may mean something more complex than mirror neurons firing in a brain and may only involve mirror neurons at a preparatory level. Indeed, mirror

neurons do not seem to support a thesis wherein an individual is uncontrollably, pre-consciously entering into the internal states of others such that two bodies "become one" through a one-to-one mirror process. Instead, this neuroscience research better supports a thesis wherein seeing others' emotional faces triggers a type of "simulation" about what one believes he/she is seeing using the resources of one's own bodily states and rehearsed cognitive firings—and this only happens in certain situations.

What should be obvious, again, at this point are the multiple frames and combinations available to researchers hearing about mirror neurons. For example, if a researcher chooses to extend the work on disgust out to all emotions in all situations, then mirror neurons become the ultimate explanatory mechanism for human interaction. Incorporating the earliest work on mirror neurons as "direct" mirrors with this later work on disgust might, as an example, produce an image of an ecological human subject always intimately and affectively integrated with its surroundings and able to displace earlier visions of a rational human roaming the earth, as propagated through the liberal humanist tradition. To the contrary, if one, rather, chooses to focus on the Buccino et al. (2004) study, then the human's affectable nature may once again be limited and intimately connected to the capacity for human judgment or what might be called "rational" cognition of messages and meanings.

In short, what has been implied in these sections discussing identification and the emotions are alternative ways to view the meaning of mirror neurons in the world depending on how a researcher interprets their functioning and situates that functioning in reference to citations and other disciplinary concerns. This potential for variance is not necessarily unique

to mirror neurons; however, what is unique to mirror neurons is the popularity of the finding and the multiplicity of extensions constructed for it.

Phenomenological Implications of Mirror Neurons

In terms of its extensions, the findings have also been applied to the field of philosophy. One implication of these neuroscience studies is that mirror neurons—which usually refer to visuomotor neurons despite the fact that other types of mirror neurons may exist in other areas of the brain (Jellema et al. 2000, 2002; Wicker et al. 2003)—seem to provide a physiological basis in the brain for Maurice Merleau-Ponty's (1958) observations in *The Phenomenology of Perception* (Rizzolatti & Singaglia, 2008, p. 52). In fact, arguably, the same could be said about mirror neuron research as Michele Foucault said of Merleau-Ponty's work: "In this text, the body-organism is linked to the world through a network of primal significations, which arise from the perception of things" (Merleau-Ponty, 1958, p. ii).

Specifically, Merleau-Ponty advocates a view of perception where the sensor and the sensible world are mutually formative (p. 247-248). Thus, one's subjectivity—the illusory 'thinking and objective I'—comes into being through body-world interplay. Using what he calls the "double sensation," Merleau-Ponty argues that the experience of one's own hand touching an object while the other hand touches the first hand allows one to realize that he/she is both a subject and an object and, thus, the social and self-aware individual arises as both sensed and sensor at the same time through being implicated in the seen (O'Loughlin, 2006, p. 81). Another way of putting this is to say experience is made from reaching out—

seeing, touching, etc.—just as it is, simultaneously, made from taking in—the seeing act, the touching act—such that the seeing and the seeing act perform each other, become folded over into each other, and co-constitute a subjectivity.

Merleau-Ponty (1958) describes his philosophical perspective this way:

> Consciousness is in the first place not a matter of 'I think that' but of 'I can'… Sight and movement are specific ways of entering into relationship with objects and if, through all these experiences, some unique function finds its expression, it is the momentum of existence, which does not cancel out the radical diversity of contents, because it links them to each other, not by placing them all under the control of an 'I think,' but by guiding them towards the intersensory unity of a 'world.'… In the action of the hand which is raised toward an object is contained a reference to the object, not as an object represented, but as highly specific thing towards which we project ourselves, near which we are, in anticipation, and which we haunt (p. 159).

In this quotation, Merleau-Ponty almost eerily describes some of the mirror neuron findings some thirty-four years too soon. Indeed, the phenomenological qualities he theorizes—that of "linking" objects together through a biological existence that has at its center an "intersensory unity"—have been, in the wake of mirror neuron research, picked up and re-theorized in Philosophy, specifically in relation to emotional experience.

Dieter Lohmar (2006), as one example, suggests that mirror neuron research evidences the idea that humans can experience "co-feeling" or have a "phantasmatic co-sensing," despite the fact that each situational "co-feeling" is likely to be different and may be qualitatively closer or farther from the feelings of the subject observed. He states, "if a

person is reporting to me about a painful accident caused by broken glass while washing up, my co-feeling is totally different from the case when she reports about the death of a close relative" (p. 5). Lohmar concludes that "we are not confined to a single consciousness" but that "we co-feel others' feelings and co-enact their bodily actions without acting… we experience an unavoidable proximity and a cognitively immediate bodily equality" (p. 15) Because Lohmar's conclusion is not specific to the functioning of mirror neurons as goal-related and because it does not take into account the co-constitutive influence of symbolic environments and the possibility of pre-dispositional anti-co-feeling elements existing in cognitive experience (Massumi, 2002, p. 31),[6] the conclusion is only vaguely in accord with the mirror neuron research and phenomenal experience.[7] Even so, the point for the time being is that mirror neurons have philosophical implications, have a variety of possible animations and interpretations, and have associations with Merleau-Ponty's writings.

This fact is recognized by several neuroscientists studying mirror neurons. Rizzolatti and Singaglia (2008) quote Merleau-Ponty three times in their landmark book on the subject.

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[6] Massumi discusses Spinoza in these pages to argue that "the body, when impinged upon, is described by Spinoza as being in a state of passional suspension in which it exists more outside of itself, more in the abstracted action of the impinging thing and the abstracted context of that action, than within itself" (p. 31). In short, the affect is constituted by the rehearsed form of an encounter, and if this is true, then there is no reason to believe that mirror neurons equate to experience in any way equal to what is being observed.

[7] Lohmar can make this strong claim about unavoidable proximity because he sets up the premise that every action has a goal; in this way, he supports the idea that all actions must have a mirror-neuron-like equivalent that creates those same feeling-types in the observer. See: Lohmar, 2006, p. 10. As will be discussed in later chapters (in the analysis of animations of mirror neuron research in the field of Phenomenology), Lohmar must presume that mirror neurons are in all cases consciously felt and that all actions have a goal in the same sense as what neuroscience researchers mean when they say mirror neurons activate in correlation with "goal-related actions."

Additionally, Gallese (2004), one of the original researchers of mirror neurons, appeals to Merleau-Ponty's work as additional evidence for his own neuroscientific discoveries. Gallese states, "The mechanism of action understanding, based on the mirror neuron mechanism, is conceptually similar to the proposal for how action understanding takes place according to phenomenologists, and Merleau-Ponty in particular" (2004, p. 2) Gallese then uses Merleau-Ponty's (1962) explanation for how movement is internally understood even though "the sense of a gesture is not given" (Merleau-Ponty, p. 185) as a way to explain how mirror neurons function (Gallese et al., 2004, p. 2). In other words, Gallese blends Merleau-Ponty with mirror neurons or, at least, chooses to use Merleau-Ponty as a "passage point" (Latour, 1987, p. 150) for interpreting mirror neurons.

These discursive moves to bridge phenomenology and the neurosciences allow, nearly request, the Humanities—a set of fields dedicated to understanding human experience—to enter into an exploration of neurobiology, while they simultaneously position the neurosciences as a key explanatory gatekeeper of human experience, integral to a complete knowledge of the human. Because of the way that founding researchers of mirror neurons have incorporated philosophical sources as means of interpretation for mirror neurons (See: Gallese, 2001), the finding is that much more potent and discussable among multiple audiences.

Even so, despite setting up mirror neurons as compatible with numerous academic disciplines concerned with perception and the human, the construction of any mirror neuron knowledge is, once one reads through the neuroscience literature, continually called into question. The neurosciences themselves seem unable to settle much of what has already been

said about mirror neurons. Their function and very existence are still under strong debate. Ironically, though, the numerous lines of debate, too, enable more animations and interpretations.

Controversies Surrounding Mirror Neuron Research

Questionable Evidence for Mirror Neurons in Humans

Turella et al. (2009) poses an interesting, albeit basic, question. They ask: "has this body of research demonstrated without reasonable doubt that exactly the same human brain area is activated in both the execution and the observation of a similar action (as happens for the monkey mirror neurons)" (p. 11)? Their ultimate answer is a flat no. They argue that there is not yet neuroscientific evidence to support "the substance of speculations" about what mirror neurons are said to do in humans—that is, explain how imitation happens, how individuals predict other people's actions, how individuals feel emotions for others, etc. (p. 11). Turella et al. build their argument from an in-depth analysis of studies that, up to 2009, sought specifically to locate human neurons firing both when an action was seen and when an action was executed.

The first study they analyze—by Rizzolatti et al. in 1996—offered mixed results and is, thus, judged as inconclusive. The second study—by Hamzei et al. in 2003—wrote its results from "merging data from two different experiments" and used a method of analysis that did not allow for generalization, especially given it had a small sample size of six (Turella et al., 2009, p. 13). It was, consequently, disregarded as poorly executed and

insufficient. The third study—by Grezes et al. in 2003—tested the sight of an object being gripped, comparing fMRI brain scan imagery to what was detected when the subject actually gripped the object; however, that study only showed the participants a view of the hand that was gripping an object, which may have "confounded" the participants, and in the end, "the analyses did not reveal any activity within 'mirror' brain areas for the conditions which in principle were particularly suited to elicit such activity" (Turella et al., 2009, p. 13). The fourth study—by Shmuelof and Zohary in 2006—tested fourteen participants watching an object be gripped but only tested nine of them gripping an object; further, the study did not ensure that participants gripped the object in the same way. Additionally, the "mirroring" effect that was witnessed did not occur in the motor regions one would expect, namely the rostral part of the inferior parietal lobe (Turella et al., 2009).

Turella et al. then go on to argue that other types of studies, such as those looking for areas of the brain involved in imitation, have not "clearly demonstrated activation specifically related to mirror areas" (p. 16). They suggest that the areas that do seem to light up from an fMRI brain scan may, in fact, "serve as cues as to when to perform the requested movements rather than a specification of what is required to be performed" (p. 17). Furthermore, they question how some authors could argue for mirror neurons as a basis of imitation when monkeys like macaques have been proven to have mirror neurons, but it is still an open question as to whether they imitate (Lyons et al., 2006), at least in the same sense as humans imitate (p. 17).

Finally, Turella et al. (2009) argue that the identification of a mirror neuron system in humans could be dependent upon how one chooses to interpret fMRI results. One could

adopt a common-coding interpretation, for example, and assume that clusters of neurons activating in two different situations “contain neurons that are engaged in a common computational process” (p. 18). Or, alternately, one could adopt a functional independence interpretation that allows for “functional independence in overlapping extrastriate cortical regions” (p. 18). Adopting the latter and not the former would lead to some strong qualifications in claiming that what one sees on an fMRI scan is, in fact, a mirror mechanism.

However, Gallese and Stamenov, in their 2002 edited collection on the subject of mirror neurons, put forward a study completed by McGlone et al. (2002), which was not addressed in the Turella et al. (2009) piece. Gallese and Stamenov argue that McGlone et al. provide “evidence in favor of the point that there is a MNS [Mirror Neurons System] area in the human brain” (p. 5). Studying thirteen participants, McGlone et al, used an fMRI scanner to look for mirror neurons by asking participants to watch a video of a person picking up a pen, a video of a person picking up coins, and a static picture of the actor and the object. Their results showed activation in inferior frontal gyrus motor areas for the video involving the pen and some activation in other surrounding areas for the video involving the coins but little activation in those areas when the static image was shown. Yet, despite Gallese and Stamenov’s endorsement, McGlone et al. admit in their article that their study is inconclusive on two levels.

First, the activations for the different tasks were unevenly distributed and unevenly accentuated; they theorize that problems may have occurred because the pen featured in the video was capped—since mirror neurons have been shown to represent goal-related tasks, the pen in the video may not have been seen by participants as being picked up for the purpose of

engaging in a pen-specific goal. Second, the authors admit that the method of showing images to fMRI participants may, itself, be problematic. They state:

> With all fMRI experiments subjects view images via mirrors [while in a tube, laying on their backs]…There has been a recent interest in mirror reflections of self, and the coding and recoding of peripersonal space (Tipper et al. 1998; Tipper et al. 2001; Maravita et al. 2000), where it has been shown that stimuli presented in a mirror are treated as if they were in peripersonal space and not in physical space. This higher order re-representation of allocentric space into egocentric space, purported to be due learning based, may well explain some of the confounding findings from these imaging studies (p. 132).

Three additional limiting factors to the McGlone et al. study, which go unmentioned in their own article as well as in Gallese and Stamenov's 2002 article about the study, are as follows: first, McGlone et al. did not ask participants to actually pick up objects themselves. Instead, the study compared videos of people picking up objects to static images of those people and objects. Consequently, it remains unclear how the study could have, from its design, detected mirror neurons at all, at least with any certainty. The study could have detected neurons firing in the motor areas, but it would have remained an open question as to their mirror properties. Second, the study was not able to transcend critiques in Turella et al. (2009) that seeing only a hand picking up an object may produce confounding results, since McGlone et al. only featured hands. Finally, the study did not account for the fact the results offered may be a direct product of a too-specific method of interpretation that suppresses the possibility of functional independence in motor areas.

With that said, many researchers (Gallese et al., 2011; Rizzolatti, 2010) continue to believe that mirror neuron systems do exist in humans and that the totality of evidence from multiple studies into imitation and emotion support the view such that the flaws in the studies mentioned by Turella et al. (2009) do not necessitate ruling out the existence of mirror neurons in humans. Indeed, Rizzolatti and Singaglia (2010) crafted a literature review for *Nature Reviews Neuroscience* wherein they tried to prove mirror neurons do exist in humans. Their argument most convincingly appeals to a 2007 study by Filimon et al., which found "overlap" in fMRI-measured activation when subjects watched a reaching arm, when subjects reached with their own arm, and when subjects imagined reaching (p. 1315). In this way, Filimon et al. avoided finger-hand and hand-object interactions that previously provided ambiguous results (p. 1316).

In addition, Helen Thomson, a writer of *The New Scientist*, also attempts to put the controversy about human mirror neurons systems to rest in her 2010 article on Dr. Roy Mukamel's (2010) study wherein his research team recorded "brain activity in the medial frontal and temporal cortices of 21 people awaiting surgery to treat epilepsy, while they made - or observed others making - grasping actions and facial expressions" (p. 12). She argues that they captured "empathetic mirror neurons" firing in humans because "8 per cent of the cells responded to both [seeing the action and doing the action]" (p. 12). It is difficult, however, to fully weight the claim, especially in regard to the idea of "empathy." This is because the Mukamel et al. study gives no discussion of "empathy" in the study—the word does not even appear in the paper—and because the study mixed results of hand-grasping actions and facial expressions in the totals reported (See p. 751). In addition, Mukamel et al.

tested “smiles and frowns” without discussing the potential importance of the convincing versus non-convincing nature of those viewed actions. Further, the study reported most neurons responding only to action-execution, not action-observation, and witnessed, ultimately, no “mirror neurons” activating in any of the typical, expected mirror neuron motor areas.

In a commentary on the Mukamel study written for *Current Biology*, Keysers and Gazzola (2010) recognize that Mukamel and colleagues did not record mirror neurons in the areas “classically associated with mirror neurons,” but Keysers and Gazzola reinterpreted the findings as suggesting that “we should stop considering certain brain regions as intrinsically ‘mirror neuron regions’ (p. R353). This is, it seems, an odd statement to make since it assumes there are already such things as mirror neuron regions even while the Mukamel article is being brandished for being the one article to conclusively discover mirror neurons in humans—their title is: “Social Neuroscience: Mirror Neurons Recorded in Humans.” Nevertheless, Keysers and Gazzola claim with absolute certainty that “the new work of Mukamel et al. brings us two leaps further in our understanding of this system: we now know that humans have mirror neurons, and we know that mirror neurons are not restricted to the premotor and inferior parietal cortex” (p. R354).

What this long controversy suggests is the ability to argue quite convincingly, on either side, for mirror neurons as central or as meaningless to human life as well as a tendency, perhaps, to see in mirror neurons what one is already prepared and hoping to see. As rhetorical scholar Lawrence Prelli (1989) has shown, scientific researchers can always call into question one of four stasis of scientific practice: the evidence, the method used, the

value of the work, or the meaning of the work (p. 44). As numerous Science and Technology Studies scholars have noted, controversy is never truly resolved but merely settled by abandonment or by agreement; until such a time when a finding secures strong enough agreement to discourage disagreement or until a finding is no longer interesting to a community of researchers, multiple meanings and messages can be circulated (Collins, 1985; Collins, 1999; Collins & Pinch, 1993; MacKenzie, 1978; Latour, 1987). Thus, when a finding like mirror neurons comes along, which touches multiple academic communities, on-going discussions and competing interpretations are likely to flourish and not easily settle or disappear.

Imitation and Controversy

Interpreting mirror neurons as central to the human ability to imitate has also engendered controversy and has set-up alternate sides of a debate open to reception by interested researchers in other fields.

Some neuro-psychological studies focused on human participants have argued that imitation is a process of working to achieve a perceived goal. Wohlschläger and Bekkering (2002), for example, found that people order acts, recognizing the key goal of an act and taking certain motor behaviors as secondary to the main goal. This finding, in the words of Stamenov and Gallese (2002), makes imitation “the copying of goals and intentions of others rather than the copying of movements. This new view implies that action-understanding is a prerequisite and precursor to imitation” (p. 4). However, this finding, which positions mirror

neurons at an essential and low-level of processing, is not easily correlated to mirror neuron research and has been subject to controversy.

Not unlike Turella et al. (2009), Lingnau et al. (2009) argues that a series of imitation exercises analyzed in fMRI studies present no good evidence that mirror neurons exist in humans and that they, consequently, do not support imitative behaviors. Laying out two prime conditions that must be met, Lingnau et al. (2009) argue, first, that fMRI studies must show specific overlap of neuron areas activating when a subject sees an action and when a subject does that same action and, second, that they must show that the "mirror neuron" areas activating are "not from a prior nonmotor categorization on the basis of inferences about potential motor acts from minimal visual cues" (p. 9925). However, according to Lingnau and colleagues, no studies meet these conditions[8]. Indeed, by setting up an experiment that required participants to continually imitate an action that remained independent of any detectable meaning and by showing no signs of adaptation in the so-called "mirror neuron areas" as a result of the experiment, Lingnau et al. (2009) argue that mirror neurons simply do not underpin imitation in humans, nor do they, for that matter, support a strong view of "action-understanding." They state, "Our data are compatible with the assumption that responses in mirror neuron areas reflect the facilitation of the motor system because of learned associations between semantic representation of actions and their generating motor programs" (p. 9926). Put in simpler terms: actions are symbolic, and the motor system is

[8] Lingnau and colleagues do not mention the Filimon et al. (2007) study; however, the reason is likely because that study sought to locate mirror neurons without conducting imitation exercises. The Filimon et al. study merely looked for overlapping regions when a behavior was seen and then executed. Lingnau seems, rather, concerned with disproving the idea that mirror neurons undergird imitation.

"trained" to respond to those symbols in the "covert generation of a motor command" (p. 9927), but this does not equate to imitation. Further, they argue this does not equate to "action-understanding," which would suggest that "mirror neurons" adapt if the same action is repeated over and over because they would be coding that act as meaningful. Instead, Lingnau et al. (2009) argue that the neurons that are seen firing in the motor area do not adapt and, consequently, they may be reacting to a "prior nonmotor categorization on the basis of inferences" and, ultimately, do not equate to mirror neurons as "mirror neurons."

These findings stand in opposition to Jeannerod's 1994 study as mentioned earlier, which argue for imitation through "internal motor representation." But Rizzolatti and Singaglia (2008) may be capable of dealing with Lingnau's implications by asserting their softer stance on the issue of mirror neurons as responsible for imitation through action-understanding. They state, "Our use of the term 'understanding' does not necessarily mean the observer (in our case, the monkey) has explicit or even reflexive knowledge that the action seen and the action executed are identical or similar. What we are saying is much simpler: we are referring to the ability to immediately recognize a specific type of action" (p. 97-98, italics in original). In other words, putting mirror neurons in the role of recognition, not in the role of active processing for generation may cope with some of Lingnau's experimental design, which is focused on short-term adaptations in specific brain regions. Of course, at some point, generation of "recognition" must occur—things must be recognized—but Lingnau's study may not be fully sufficient to examine that process; thus, "motor representations" may be viewed from the stance, which Rizzolatti and Singaglia seem to

support, that they play an important role in imitative behavior, despite the fact that the full functional cognitive process is not yet mapped.

Action-Understanding Controversy

Pierre Jacob (2008) suggests mirror neurons have been understood in completely the wrong way and that this bad understanding leads to a false belief in mirror neurons as the basis for action-understanding, which has been said to give a person the ability to understand other's behaviors or "read minds." Jacob begins his argument by asserting that mirror neurons were initially understood as "a replicative or resonance mechanism" that constitutes "an automatic mental simulation of the agent's observed movements" and, thus, enables "the observer to recognize the agent's action, or even to represent her intention" (p. 191). The problem, however, he suggests, is that "the reasoning used to link MNs [mirror neurons] to mind-reading borrows concepts from the simulation approach to mindreading" (p. 191). In short, Jacob suggests that simulation cannot account for mindreading, and to assume it can is an error. He states, "motor resonance is neither a necessary nor a sufficient mechanism for representing an agent's intentions" such that one simply cannot know "what an agent has in mind" from her/his motor movements (p. 192-193). In fact, he argues that even if simulation were a necessary condition, this does not mean it is sufficiently the cause of knowing what other people have in mind; but more so, Jacob states that even if simulation were taken as a sufficient condition for mindreading, then one could still uphold that mirror neurons should not automatically be assumed to be replicative, but, rather, that they could be predictive (p. 191). That is, instead of "replicating" or "identifying" with others, Jacob suggests that there

is nothing in the mirror neuron research to argue against the idea that mirror neurons are predicting through an “efferent copy” of what those actions might mean. Jacob argues that so-called “mirror neurons” may not be—and likely are not—an embodied simulation of another in the way mirror neuron researchers like Gallese and Rizzolatti try to assert. This is because mirror neurons have no correspondence or do not “mirror” the motor repertoire in another person’s brain. “Mirror neurons,” in other words, respond not as a simulation that inherently “links” one person to another through similar neuronal or affective resonances; consequently, they may only be a predictive mechanism reacting quickly out of or from the past repertoire of one’s own motor movements and would show difference depending on one’s experience, attention, situational limitations, etc. (p. 202).

Cisbra (2005) makes a similar argument on similar grounds. He contends that “the evidence published on the response properties of MNs in monkeys is incompatible with these theories of action-understanding because (a) MNs' activation reflects not the commencement but the conclusion of action interpretation and because (b) MNs do not 'mirror' observed actions with sufficient accuracy for effective simulation” (p. 1). As a result, Cisbra argues that mirror neurons in monkeys do not “simulate” an action and “directly match” what is seen to a monkey’s own body movements; rather, they, at best, make broadly congruent the goal being enacted with some motor movements. This means, in Cisbra’s view, “mirror neurons seem to play a role in representing high-level, abstract relations between actions and subsequent states or actions” but that the best argument as to why they do so is because “they are involved in the prediction or anticipation of subsequent—rather than in the simulation of concurrent—actions of the observed individual,” which would “entail that mirror neurons,

despite their name, do not 'mirror' actions" (p. 4-5). In other words, Cisbra, like Jacob, argues that mirror neurons do not need to be understood as simulations that "mirror." Their involvement in "understanding" motor acts of others is just as likely to be about predicting future actions or outcomes.

Emotions and Controversy

Rizzolatti and Singaglia (2008) assert that the research on disgust (Adolphs et al. 2003; Wicker et al., 2003) "confirms the hypothesis that the understanding of emotive states of others depends on a mirror mechanism that codes the sensory information directly in emotional terms" (p. 186). Furthermore, they argue from studies by Hutchinson et al. (1999) and Singer et al. (2004)—which show single neuron activity during both "the application of a painful stimulus to the patient's hand and when the patient watches this stimulus"—that pain is also mediated by a mirror mechanism. Gallese (2006) interprets Adolphs' and Wicker's findings, and presumably the others as well, in this way: "The other's emotion is constituted, experienced, and therefore directly understood by means of an embodied simulation producing a shared body state" (p. 50). Indeed, Enticott et al. (2008) seems to agree, arguing that there is some, although limited to certain circumstances, correlation between facial processing and known mirror neuron areas. Cheng et al. (2009) throws support to the theory, appealing to psychological studies showing females have a higher "ability to perceive and respond with care" in an effort to inform their own brain imaging study that reports more grey matter—denser brain structures—in females in the typical mirror neuron areas than in those same areas in males, suggesting, ultimately, that mirror neurons are involved in

"empathy" (p. 717-718). Through this method of interpretation, they argue that their findings "lend support to the extreme male brain theory" (p. 718) that associates Autism with males (See: Bar-Cohen et al. 2005).

However, reproducing another's emotion—whether disgust or pain—is not equivalent to the activation of mirror neurons, and understanding the emotions that another is experiencing does not equate to actually experiencing them. In fact, mirror mechanisms have not been shown to reproduce what others are feeling in the sense of "mirroring" emotions, and it is questionable whether they play a part in understanding emotions. This is precisely the point Decety (2010) makes when he argues "it is not at present possible to conclude that it [a mirror neuron mechanism] is critically involved in emotion recognition, and there is little evidence for its role in empathy (p. 205). He states, "The idea that the MNS is implicated in emotion perception mainly relies on studies that reported activation in the inferior frontal gyrus during the observation and the imitation of facial expression of emotions… However, the majority of functional neuroimaging studies have not reported activation of the MNS during the perception of facial expression of emotion (see Murphy, Nimmo-Smith, & Lawrence, 2003 for a meta-analysis). More disturbing and worth mentioning is that several studies claiming to have found MNS activation did not have the appropriate experimental conditions to support such a claim" (p. 205-206). He goes on to argue that studies showing overlap, even in non-traditional mirror neurons areas, between a participant perceiving emotions in others and experiencing them personally "may simply reflect a general aversive response coupled with motor preparation for defensive actions" or activation in the same neural areas when viewing others might show "valence, arousal or

approach and withdrawal," not necessarily "mirroring" (p. 206).

In addition, controversy remains around the relation between mirror neurons and emotions, since as Jack (2010) shows, neuroscience studies evaluating emotions do so in many different ways—through facial expressions of different types, sounds, situations, smells—and most take the term "emotions" or "empathy" for granted, giving the term little definitional support (p. 420). This happens despite the fact that conceptualizations of "emotions" are cultural and change over time (Gross, 2006, p. 6). This point is also supported by Decety (2010) who suggests neuroscientists have not, but certainly should, distinguish between empathy and sympathy, making sympathy an understanding of another's emotional state and empathy felt "congruence" with it (p. 204). Even so, what "congruence" means in one case is likely to be different in another case and involve varying degrees of intensity across bodies and situations. Nevertheless, the point remains that current studies "generally confuse having emotions, understanding of the reasons they occurred, emotional reactivity, and emotional appraisal" (Decety, 2010, p. 206-207). Consequently, like most claims involving mirror neurons, the research on emotional understanding and "mirroring" remains fairly inchoate and under contestation. As a result, the force and meaning of mirror neurons remains multiple, open, and full of possibility.

Conclusion

This chapter has not only defined mirror neurons but has demonstrated their influence across a wide expanse of issues, including what visual perception means, how imitative behavior mechanisms operate, how actions can be understood by others, and how emotional

identifications might be made possible. For each issue, this chapter has outlined the relevant research, but it has also presented competing interpretations of these neuroscience findings and offered multiple critical accounts. Ultimately, understanding the variety of ways mirror neurons have been studied, conceptualized, and called into question within the neuroscience community allows for a better analysis of how mirror neurons can be situated in multiple ways and might produce quite different logics in non-neuroscience disciplines.

The following chapter details the methodology that will be employed in chapters 4 and 5 to explore the translation of this mirror neuron research in other fields.

CHAPTER 3:
METHODOLOGY:
ANALYZING THE TRANSLATION OF MIRROR NEURON RESEARCH

This methodology introduces the theoretical position of the researcher, describes the analytic objectives of the project, outlines the organizing research questions, and details the processes followed to answer them. The goal of the chapter is demonstrate how the objectives enable research questions that, in turn, form the basis for a sampling method and coding scheme.

The Theoretical Position of the Researcher

Scholars in the rhetoric of science (Fahnestock, 1986; Prelli, 1989; Gross, 1990; Miller, 1992; Pera, 1994; Ceccarelli, 2001b) have demonstrated that the practice of science is never unproblematically neutral and that the production of science is always rhetorical and partial. Lawrence Prelli (1989) puts it this way: “scientific knowledge is not ‘found’ or ‘discovered’ by applying formal algorithms which compel agreement and secure consensus, but is itself socially constructed and negotiated” (p. 4). Scholars working in Science and Technology Studies have also noted that scientific findings are dependent on mediating structures (Hutchins, 1997, p. 338) and are open to multiple interpretations and negotiations such that “nature alone does not provide a determinate outcome to scientific debate” (Pinch and Bijker, 1987, p. 40). Consequently, while Robert Merton (1973) rightly notes that “The institutional goal of science is the extension of certified knowledge” (p. 270), it remains the

case that "insofar as all human 'knowledge' is developed, transmitted, and maintained in social situations, the sociology of knowledge must seek to understand the processes by which this is done" (Berger and Luckmann, 1966, p. 3). In line with the sociology of knowledge and an epistemological perspective that stresses knowledge-production in a realm of contingency, the following study investigates how the term and science behind "mirror neurons" are (re)constructed across disciplinary mobilizations seeking to develop and certify new knowledge. Thus, the study does not simply observe the rhetorical-ness of mirror neurons but traces the rhetorical lineage across discursive networks to see what actors mobilize and are mobilized by the scientific discourse, developing a better understanding of the "epistemic machinery" (Knorr-Cetina, 1999, p. 3) underlying several non-neuroscience disciplines' animation of neuroscientific information.

The study, therefore, takes as essential the need to understand language use as socially "situated" (Gee p. 94) as well as the need to understand that the language of the neurosciences is highly appealing and influential (Beaulieu, 2002; Racine et al., 2005; Jack, 2010) and is now being used for disciplinary fact-building and theory-building across the university (Slaby, 2010; Johnson and Littlefield, 2011). In other words, the study presumes that scholars working in the Rhetoric of Science as well as in Science and Technology Studies understand the value in "account[ing] for the production, dissemination, and appeal" of the neurosciences (Jack, 2010, p. 408) within a university system that builds and certifies new knowledge. Indeed, the study locates its importance in exploring how scientific productions are animated from and between socio-cultural categories, popular arguments,

and situated histories[9] of various fields, which construct and certify new theories and practices in those fields. More broadly, a "neuroscientific turn" in these academic fields stretches the influence of the neurosciences out beyond where it is already felt in the university, out to technical and technological developments designed for communities of lay practitioners. In fact, if "Western contemporary societies are in one sense or another ruled by knowledge and expertise" (Knorr Cetina, 1999, p. 5) such that, as Giddens (1990) notes, social relations are re-ordered in light of new knowledge products (p. 7), then the neurosciences have impacts not only within the university but on larger social relations and require critical analysis.

The following study looks to verbal data analysis (Fairclough, 1993, 2003; Geisler, 2004; Van Dijk, 2008; Gee 2005) as an entry point for a neuro-rhetorical analysis (Fahnenstock, 2005; Jack, 2010) that builds from Jordynn Jack and Gregory L. Appelbaum's (2010) call for a "Neurorhetoric" that explores the knowledge-work of the neurosciences and critically interprets the dissemination and reinterpretation of scientific findings (p. 414). Combining these perspectives, the study ultimately identifies and investigates a range of peer-reviewed journal articles employing neuroscientific information about mirror neurons from across four non-neuroscience disciplines, including robotics engineering, group analysis, phenomenology, and movement therapy. The study takes Geisler's (2004) suggestion as its starting point, i.e. that data analysis as a method, specifically, combines "the insights of intuition with enough of the systematics of methodology to provide reasonable

[9] Jack (2010) makes this same argument about the historical and contingent development of scientific productions in her article, pg. 408.

grounds for argument" (p. 2). In other words, the process of identifying relevant textual features across a set of texts, locating patterns, and analyzing the patterns through a close analysis of characteristic examples will support an argument about how words, phrases, and other structures correlate with the communicative function being enacted (Gee, 2005, p. 25).

For this study, exploring how four fields construct new knowledge from neuroscience research is a large task that would have difficulty achieving a comprehensive analysis from a traditional close rhetorical reading. The study will, therefore, work through the development of a set of codes under the guidance of the methods of the quantitative descriptive approach, also termed data analysis, which can be used to locate how the neuroscience is made to "fit" the concerns of a field, a process Michael Callon divides up into specific "moments of translation" (Callon, 1986). The study will explore how characteristic those moments are and how they are enacted on the sentence-level, enabling a rhetorical analysis from key examples (LeCompte, 2000). Turning to codes for an initial purview of translational moments, however, necessitates understanding what exactly "moments of translation" means and covering the attendant theory of knowledge-making, typically called Translation Theory, developed within the broader umbrella of Actor-Network Theory (Callon, 1986; Latour, 1986, 1987; Klegg, 1989).

Although chapter 1 contains a detailed discussion of Actor-Network Theory and translation (See: pages 12-21), it will be beneficial to briefly review the central idea so the segmentation and coding scheme will make sense in the context of this chapter. Latour (1986) describes translation this way: "the spread in time or space of anything—claims, artifacts, goods—in the hands of people; each of these people may act in many different

ways, letting the token drop, or modifying it, or deflecting it, or betraying it, or adding to it, or appropriating it" (p. 267). Preston et al. (1992) understands translation as a "fabrication process" wherein skeptics are overcome by putting together support networks and changing the meaning of an object's use (p. 589). Callon (1986) states that translation is a process "during which the identity of actors, the possibility of interaction and the margins of manoeuvre are negotiated and delimited" (p. 6). What results from an analysis of translation, then, is how some new "reality" is made, how the conception of an academic discipline, for example, is re-arranged and changed when the neurosciences are incorporated or present a new exigence for the field; actors must put together new "support networks" and engage in a "fabrication process" to add or deflect and re-make the field. Perhaps, the best way to understand translation is to situate it within the broader development of Actor-Network Theory (ANT).

Smith et al. (2010) explain that ANT explores how networks are assembled or disassembled and combine into a "system of associations which is called an actor-network" (p. 505). After explaining how ANT considers actors to be both human and nonhuman entities and how ANT, at the outset, gives no hierarchical agentive priority to any actor in any network, Smith et al. state that networks are "created or formed through the process of translation… The process of translation involves negotiations among human and non-human actors/actants which serves to define their interests and actions in the network" (p. 505). In other words, a Theory of Translation is, essentially, a theory about how actor-networks form—through rhetorical alliances that can be divided up as a series of translational processes.

Adhering to the ANT perspective, Callon (1986) defines four specific moments in the solidification process of a network, which he calls “moments of translation.” These include: 1) problematization, or when actors define a problem, 2) interessement, or when actors seek to lock other actors into specific roles to solve that problem, 3) enrolment, or when actors interrelate the roles assigned to achieve the appearance of consensus, and 4) mobilization, or when actors use means to ensure the assigned roles are not betrayed (p. 196).

Taking this basic framework, actors in documents like academic articles can be traced and understood through these moments as they, through their positioning in the text, propose and/or instantiate some kind of change—a challenge or a revision to an existing theory perhaps—and do so through defining a problem in reference to themselves or in reference to other actors, through locking themselves or others into specific roles, through interrelating those roles, and through ensuring those roles cannot be challenged or betrayed by others. Each moment of translation has a discursive manifestation in subjects, verbs, and objects. In fact, locating who or what is acting, where they are acting, who or what is enrolled as support for those actions, and who or what does not act offers an entry point into understanding how neuroscience is introduced into a non-neuroscience field and made influential within the production of academic texts.

Focusing on actors requires charting who or what (human or nonhuman) problematize a field, who or what work to make the neuroscience “fit” into the constructed conception of the field, and who or what supports that new network of actors enough to solve the problem and instantiate the change. As Latour (2005) notes, the means of analysis is “‘to follow the actors themselves,’ that is try to catch up with their often wild innovations in order to learn

from them what the collective existence has become in their hands, which methods they have elaborated to make it fit together" (p. 12). This dissertation finds pragmatic value in a Theory of Translation further systematized through qualitative data analysis, an approach that can trace how texts interconnect and can prop up a rhetorical analysis of how new knowledge-networks are assembled between multiple texts from different disciplines. The following analytic objectives further detail what this dissertation sets out to achieve with this approach.

Analytic Objectives

Analytic Objective 1: Determine what kind of translational work is being done in reference to the term "mirror neurons" in the different non-neuroscience fields and whether there are similar patterns of translation across the fields.

It is important to recognize the premise of this first analytic objective—that Translation Theory is a rhetorical theory having a common epistemological foundation as Rhetoric. That is, both Translation Theory and Rhetoric consider an actor's actions as simultaneously physical and symbolic and, thereby, influential to social and material organizations; further, both consider symbols themselves as acting (Burke, 1966; Callon, 1986; Latour, 1987) in a world where negotiation and available resources are integral to the kind of "framing activity" (Latour, 2004, p. 187); this framing activity makes and certifies knowledge, which is, ultimately, historical and contingent. The premise, then, is that

"translation," being well developed in ANT literature, captures rhetorical action and provides a lens or an approach that *is* rhetorical and can guide the rhetorical analysis in Chapter 5.[10]

In fact, the development of a systematic coding scheme that can locate ANT moments of translation provides way for a rhetorical reading to explore extensive inter-related networks. In other words, the quantitative descriptive approach gives rhetorical scholars another way to see how networks grow large and dynamic and how texts perform these translational moments as different actors and citations are quantitatively prominent or diminished. As Callon (1991) notes, "the more one reads, the more one links, and the more important it is to negotiate and compromise" (p. 139). So as the networks grow, they become more networked, and the organizing terminology changes as actors are enrolled as problem-solvers, as support, as explanations. For this reason, a coding scheme is useful. It considers disciplinary knowledge-making in academic texts as a discursive networking process that can be mapped and subsequently interpreted through Callon's four moments of translation—although they may not always manifest in a specific order or in entirety.

In line with Callon's focus on translation, then, this first analytic objective is addressed through the development of a coding scheme that can pinpoint when texts incorporate actors, position them as mediators, establish them as originating or speaking to a problem, and when actors are "black-boxed," which equates to chunking them together into a unit and keeping them from undergoing further interrogation (Latour, 1987). As a starting point, mapping the positioning of actors in texts can be functionally understood as the first

[10] See pages 13-21 in Chapter 1 for further discussion

step in tracing Callon's four "moments of translation," watching the assembly of a new actor-network (Callon, 1991).

Approaching this first analytic objective by mapping actors means that the term "mirror neurons" must be viewed as itself a discursively constructed actor and an actor-network. In short, it, too, may perform actions and be an actor through its discursive position, which allows it to, some degree, carry a certain network of relations. As Anne Freadman (2002) explains, words and phrases establish "bi-directional relations" between pairs of texts, and a new text "is contrived to secure a certain class of uptakes," ultimately making possible a process of transference (p. 40-42). Anne Marie Mol and John Law (1994) describe this transference process in their exploration of the way "Anaemia," as an actor-network, moves across contexts, sometimes changing more dramatically than at other times. They show how changes to the meaning of "Anaemia" occur in reference to the types of material and discursive practices that organize "Anaemia" and argue that the performance it demands "is a function of the relations between the [human and nonhuman, material and discursive] elements" (p. 642). Thus, mirror neurons, like the term and condition of Anaemia, are both an actor and an assembled actor-network. Accordingly, the goal of the first analytic objective is to analyze how positions of actors in an academic field of study enact Callon's moments of translation, transferring actors from one network to another, achieving change through transference to a greater or lesser degree as articles "modify, deflect, betray" in the creation of new knowledge (Latour, 1986, p. 267).

A central reason why actors, who are themselves actor-networks—like "Anemia" or "Mirror Neurons"—cannot unproblematically be transferred to another actor-network

without being affected is discursive relations between actors withhold or lend them agency, i.e. provide them with the "strategic occupation of subject positions" (Graham, 2010, p. 379) in ways that "make a difference in a given situation" (Cooren et al., 2006, p. 534). Seeing how those differences are made, ultimately, paves the way for different claims about what mirror neurons *are* and are capable of doing. In brief, mapping actors in texts moves toward achieving the first analytic objective because it answers how "mirror neurons" come to mean different things to different people; it does this by taking note of the processes of translation enacted through actors that forge and mediate different claims in different fields. The variance that happens as a term like "mirror neurons" becomes mobile and is moved from one field's actor-network to another field's actor-network by being made to "fit" into that new field highlights the point of the next analytic objective.

Analytic Objective 2: Determine the extent to which "mirror neurons" move as a dynamic signifier across non-neuroscience fields, specifically in relation to the neuroscience citations referenced.

The second analytic objective explores the extent to which the term and science of mirror neurons take on more or less meaning and support different claims across disciplinary texts. Thus, the analytic objective requires exploring, specifically, how the term is used and how the placement of neuroscience citations makes claims about mirror neurons and attempts to transfer a network of meanings into the various texts examined. Charting the dynamism of mirror neurons through marking them as actors, noting what they are doing, and following which citations support them, captures how one of the most important findings of the

neurosciences up to this moment (Stamenov & Gallese, 2002, p. 1) is actively translated and potentially transformed to support the development of new facts, theories, or practices in different fields. Without question, following mirror neurons and how they are given "agentive relations" (Graham, 2009, p. 379) by the set of networks carried over with them through citations is essential to an analysis of how "translation" may work differently in different fields and produce different meanings for mirror neurons. Thus, this second analytic objective promotes the general development of a coding scheme dedicated to tracing actors and their actions but is also addressed by tracing neuroscience citations across all texts.

With regard to tracing their actions: understanding mirror neurons as actors means tracing their associated verb forms, offering a sense of what mirror neurons are, ontologically conceptualized, through what they are said to be doing or able to do. For instance, mirror neurons that are triggered by events are different than ones that fire and cause events, and sorting through those differences enhances a picture of assumptions about the brain and informs the overall discussion happening in a text in question. Thus, mapping out the certainty of the verbs associated with mirror neurons can also facilitate an analysis intent on answering this second analytic objective focused on exploring the dynamism of terms. Mirror neurons, for instance, that reflect environments are different than ones that *might* reflect or *sometimes* reflect environments. Understanding those subtle differences in expressed through linguistic modes of certainty, especially in reference to a particular field or a particular argument, supports a rhetorical analysis seeking to discuss the transference of mirror neurons and the implications that extend as a result.

Analytic Objective 3: Determine whether the strength or the direction of an article's claim is a factor in the way mirror neuron research is translated across non-neuroscience fields.

A study like this one cannot assume that any differences in translation strategies observed across articles are necessarily the direct and immediate result of the field of study producing the article. Consequently, each article's claim will be categorized in terms of the direction of the claim it is making and the strength of the claim. This form of argument analysis can be done, first, by turning to Stephen Toulmin's (1984) definition of argument as an utterance that requires a chain of reasoning in support of a claim (p. 6). With regard to an argument's strength of claim, the argument analysis can proceed by appropriating Toulmin's discussion of qualifiers to map out three categories of qualification for claims. These include "certainly, probably, and presumably" (p. 87).

By locating the final claim of an article in the conclusion sections—or in the absence of a concluding section by locating the advance organizer in the introduction section—Toulmin's qualifiers can be applied and can indicate the strength of a claim. The first qualifier—certainly—represents claims where the "warrant is unambiguous" and "the solidity of its backing is unchallenged" (p. 86). The second—probably—holds a weaker position, wherein the "relevant grounds may point toward C [claim] strongly but not conclusively" and the "warrant may indicate a strong rather than a 100 percent correlation between the relevant facts and the present claim" (p. 86). The third—presumably—indicates an even weaker position, wherein "the warrant may be one that applies in cases like the present one *only* in certain conditions," and the claim is still tenuous enough where it can only be assumed from the data (p. 86).

In addition to "strength of claim," the argument analysis can and will identify "direction of claim." The direction of a claim indicates the goal of the claim. A scale ranging from overturning a reigning theory or reigning practice in a field, on one far end of a spectrum, to suggesting that the neuroscience supports existing practice or theory within a field with no extensions or changes, on the other far end, will be used to map the direction of an article's claim. See Figure 3-1.

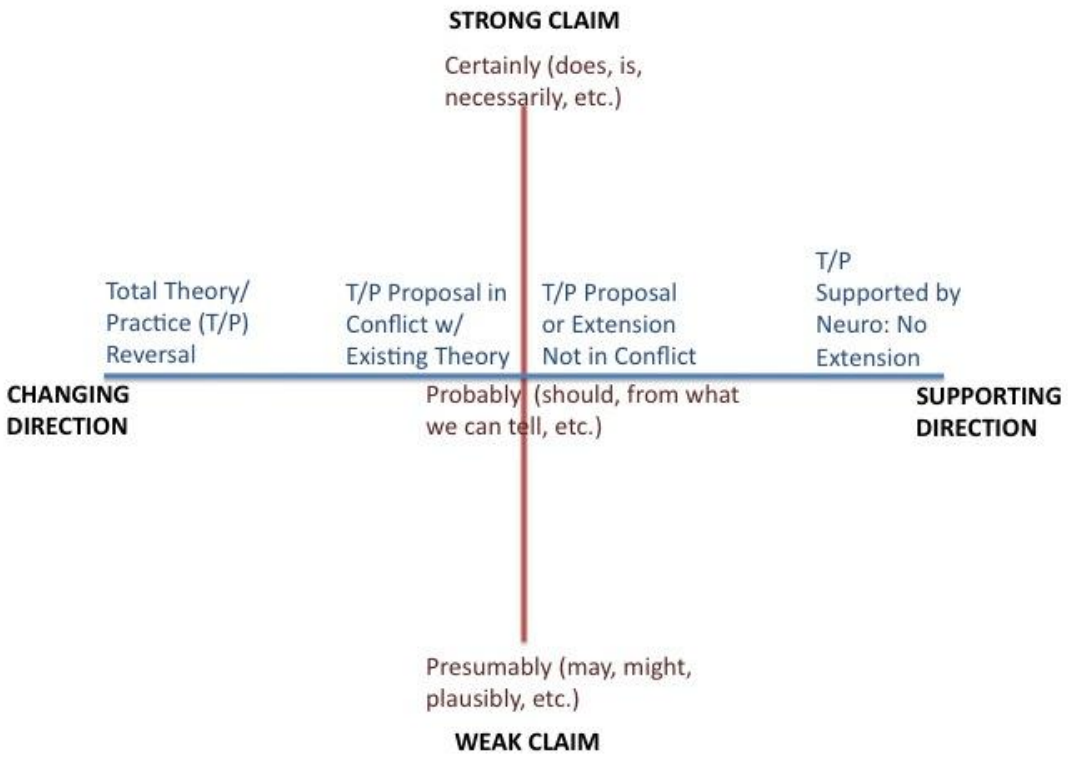

Figure 3-1. Argument Analysis – Strength of Claim and Direction of Claim

It is worth noting that qualitative data analysis identifies features a researcher suspects are in a data set. Consequently, the coding scheme that will be developed in the

coming pages is granular and does not comprise or involve this argument analysis. An argument analysis proceeds as a separate step. However, since qualitative data analysis is employed to enhance a qualitative reading, the coding sketched out in subsequent pages should enhance the argument analysis. This is the intent for this project. Indeed, the codes developed will make the argument analysis richer by pointing out details that enable an analysis to say more than it otherwise could.

One way this enhancement of the argument analysis works in practice, in this case, is through the coding of actors and verb-phrases, indicating where the strength of clauses throughout an article vary and come together to support the final, overall claim in the conclusion. In other words, the actor codes and the verb codes developed for the first two analytic objectives offer the chance to see how different stances on mirror neurons and brain research in the body of articles correlate with concluding claims. The same is true for the direction of concluding claims. Mapping when verb-phrases about mirror neurons and brains are certain or not certain enhances an argument analysis otherwise limited by its focus on concluding statements and their relative strengths.

Analytic Objective 4: Determine whether time is a factor that makes a difference in the way mirror neurons are translated.

This fourth analytic objective does not assume the irrelevance of time in understanding the processes of knowledge-construction. Thus, the project follows in a tradition pioneered by Perelman and Olbrechts-Tyteca (1958) in resisting a “totalitarian logic,” which assumes logical procedures stand independent of time and resist experience

under a rationale that an explicitly “logical” logic can order facts and form a totalizing explanation for all events across all of time (Bolduc & Frank, 2010, p. 310-311). In other words, this project remains attuned to the notion that the right or best “kairotic” time (Poulakos, 1983; Miller, 1992) for suggesting action from neuroscience research within a particular discipline is a judgment made in lieu of the time of the progression of the research, what is “known,” and the cultural time of that discipline’s familiarity and comfortability with engaging the neurosciences.

Consequently, if the discursive processes of translation prove noticeably different after looking at the quantitative descriptive data when mapped over the various times of publication for all sampled articles, then more detailed reflections on each discipline’s time of engagement with the neurosciences must and will be pursued. This will be accomplished by returning to the discussion in Chapter 2, thinking through the development of mirror neuron research and the availability of sources presenting different interpretations at the time of an article’s publication. Developing a qualitative assessment of the influence or lack of influence of neuroscience sources on specific fields and lines of argumentation is possible with this approach. Exploring what neuroscience research on mirror neurons was available, in short, and cross-referencing it with the amount of conversation in the field at the time can achieve this fourth objective.

Analytic Objective 5: Determine what lessons can be learned from engaging the first four analytic objectives and apply those lessons to the field of rhetoric as a mode of critique about the pursuit of new neuro-informed rhetorical theory.

Rhetorical scholars have recognized the importance of engaging the neurosciences at least since Jeanne Fahnestock's (2005) article, "Rhetoric in the Age of Cognitive Science," which argues that rhetorical scholars should direct attention to cognitive science due to its growing impact and due to the fact that "language is absolutely central in studies of brain and mind by both cognitivists and many neuroscientists" (p. 160). However, Fahnestock's claim that "cognitive scientists certainly are not and have not been interested rhetoric" no longer entirely holds (p. 160). Interdisciplinary and multidisciplinary partnerships are flourishing lately, as witnessed in Jordynn Jack's partnership with cognitive neuroscientists at both Duke University and the University of North Carolina at Chapel Hill. Partnerships are also evident in the Critical Neurosciences movement out of the Max Plank Institute in Berlin where an interdisciplinary group of scholars desire "a shared vocabulary for neuroscientists and social scientists" and pursue this goal by establishing conferences and supporting multidisciplinary projects that examine the language and social impact of the neurosciences (2011, p. 1).

Evidence of the dissolution of hostilities between the Neurosciences and Rhetoric, if ever they existed, can be seen as rhetorical scholars argue that neuroscience findings already do or will likely put forward new reasons for re-writing key ideas in rhetorical theory (Davis, 2008; Edbauer-Rice, 2008). Likewise, Jack and Appelbaum (2010) suggest that "neuroscience findings might also add new insights to longstanding rhetorical issues," and, thus, they hope to move scholars away from exclusively practicing the "rhetoric of

neuroscience," endorsing the "neuroscience of rhetoric" as a new addition to the scholarly repertoire (p. 413). Consequently, there now exists a need for discussion about the knowledge-making processes involved in appropriating neuroscience terminologies and pursuing a "neuroscience of rhetoric." This fourth analytic objective aims to spark that conversation and to use the disciplinary investigations summarized within the first four analytic objectives as a systematic way to offer rhetorical scholars insight into the difficulties and possibilities of animating neuroscientific information in the field of rhetoric. Chapter 6 will be dedicated to this task.

This project assumes, as mentioned in the introduction chapter, that rhetoric can be expected to behave in the some of the same ways that other non-neuroscience disciplines do when animating the neurosciences. Indeed, patterns across fields, such as those witnessed in Littlefield and Johnson's study into several different neurodisciplines' depiction of "Science," are likely to emerge from the data gathered in this study. However, this does not rule out the likelihood of unique engagements. Rhetoric will almost certainly demonstrate its own special intricacies as it advances its own argumentative claims. The same is true for other fields as well. Even so, recognizing patterns of translation could be suggestive toward a rhetoric of using the neurosciences that transcends fields and could offer insights or recommendations; or, alternately, some patterns of translation from other fields might inform what rhetorical scholars can do with the neurosciences and what they have not yet done. Whatever the case, this study is launched from the position that other non-neuroscience disciplines are instructive, that they can illuminate key rhetorical aspects of cross-disciplinary

mingling with the neurosciences, and that they can point out possibilities for invention in rhetoric.

Further, since there is currently no extended engagement of rhetorical scholarship with one particular neuroscience finding—despite the fact that this is likely to happen in the field of rhetoric in the future as the brain sciences grow more influential—looking at the long-term interaction with a single neuroscience finding in other fields that are, in this respect, "faster" than rhetoric, presents a learning opportunity for rhetoric. Seeing how scholars from one field animate and reanimate a single neuroscience finding—mirror neurons—illuminates the possibilities of use. This, again, gets at the notion of rhetorical invention, or what Jasinski (2001) describes as an inspiration from "a world of other texts and voices" (p. 329) that in LeFevre's terms (1987), constitute and develop out of an "on-going social process" (p. 96). Indeed, only by looking and drawing on "other texts and voices" can invention proceed. And one existent potential within this dissertation project is the rhetorical scholar's ability to situate the neurosciences and the other disciplines engaging neuroscience research as inventive resources. Moreover, if any existing neuroscience finding is likely to be engaged multiple times in the field of rhetoric, then that finding is certainly mirror neurons, especially since it resonates with a broader drive to theorize "affect" in the Humanities and since Diane Davis (2008, 2010) has already used the finding in a magnanimous way that will likely elicit responses—not unlike the one offered in the first chapter of this dissertation. As a result, looking at how other fields have explored mirror neurons serves as an advance warning or an advance preview for where rhetorical scholarship is likely to go.

Sampling Method

The first step in this project is to choose multiple articles using the term "mirror neurons." Thus, the following section outlines the sampling method, shows how it follows from the analytic objectives described above, and then proceeds to define an appropriate coding scheme from specific research questions that can speak to the objectives.

In order to choose texts that can address the analytic objectives, the study required identification of several different non-neuroscience disciplines engaged in conversation about the implications or uses of mirror neurons. Thus, articles were initially selected through a criterion-based sampling method (Merriam, 1988), which made use of the SUMMON library database, a Quicksearch federated search tool at the North Carolina State University library with specialized search modules ("Quicksearch"). The criterion-based sampling method took into account article content, date of publication, and place of publication. This overall criterion rested on four basic assumptions. First, the articles needed to be written after the first journal publication about mirror neurons in 1992 (Di Pellegrino et al., 1992). Second, the articles needed to be centrally organized around the term "mirror neurons," not merely have mention of the term in the article, and, therefore, self-describe with that term. Third, the sampled articles needed some indication of their own level of authoritativeness, e.g. for academic articles, they needed to be peer-reviewed. Fourth, the articles needed to be widely circulated and available across the academic disciplines. Consequently, I chose the SUMMON database due to its ability to search journals across all of the academic disciplines with a criterion set to full-text, peer-reviewed, academic articles only, self-describing with

the term "mirror neurons" and published between January 1st, 1992 and January 1st, 2011, using the search term "mirror neurons" to locate relevant possibilities.[11] In the end, the search yielded 394 results. The first 164 original titles were chosen when those results were organized by relevance,[12] a number of titles large enough to offer at least ten disciplinary categories and small enough to keep the study focused and manageable.

In order to understand which disciplines were discussing mirror neurons, this initial sample of articles was divided by the academic discipline most closely identified with the parent journal. In other words, an article titled "Making sense of mirror neurons" published in the journal *Synthese* was identified with Philosophy, an article titled "The role of mirror neurons in processing vocal emotions: evidence from psychophysiological data" published in *The International Journal of Neuroscience* was identified with the Neurosciences, and an article titled "Emotion, Embodiment and Mirror Neurons in Dance/Movement Therapy: A Connection Across Disciplines" published in *American Journal of Dance Therapy* was identified with the Arts and later more specifically categorized under articles representing Movement Therapy. Because many of the articles bridged disciplines or addressed interdisciplinary concerns, disciplinary categories were developed in "an iterative process"

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[11] Note: the date 1992 was chosen as the earliest possible beginning point for the text sample.
[12] Relevance is determined through a complex algorithm that, for the SUMMON database—like most databases that draw on other databases—is a closely guarded market secret. An attempt to acquire the algorithm through the North Carolina State University library representative was made, and the request was denied. Nevertheless, the articles appearing in the SUMMON search results were compared to the citations in the sampled articles, i.e. the researcher tried to locate similar articles from that field by examining the citations in the articles delivered by SUMMON in order to discover whether the SUMMON database provided those other articles as well. The impression of this researcher was that the SUMMON database provided good coverage of the Conversation surrounding mirror neurons in each field when the database was searched by relevance.

(Geisler, 2004) going back and forth between the sampled articles and the disciplinary categories appearing most often in the journal descriptions available on the SUMMON database. This general method, also known as constant comparison (Miles & Huberman, 1994), offered a comprehensive way to develop disciplinary codes that could forge useful patterns, facilitating contrasts needed to achieve the analytic objectives. Ultimately, 10 disciplinary categories were established.

The articles were then further segmented into what Gee (2005) calls different "Big 'C' Conversations." That is, based on the phrases and motifs in the titles and abstracts, the articles were further coded into different lines of debate happening within the disciplines (p. 35). This process allowed for a cross-referencing of the formal discipline and the Conversation such that articles from the same disciplinary perspective exploring a single Conversation happening outside the neurosciences could be sampled; or put differently, this avoided conflating scientific Conversations about the empirical aspects of mirror neurons from non-scientific Conversations seeking to use mirror neurons, and it also avoided conflating articles from radically different perspectives exploring the same Conversation or articles from the same disciplinary perspective exploring different Conversations. The coding process yielded 14 identifiable Conversations from a non-exclusive coding scheme where articles could be coded as addressing more than one Conversation. The results produced a range of Conversations from "childhood education pedagogy" to "robot engineering" to "therapy in group analysis." See Appendix A.

After coding the sample for both the general academic discipline and the specific Conversation engaged, the results were as follows: 70 articles appeared from the broadly-

defined Neurosciences, 29 from Psychology or Psychiatry, 20 from Philosophy, 19 from Biology, 9 from Group/ Interaction Studies, 6 from Robotics Engineering, 6 from the Movement Arts, 4 from Specialty Journals covering specific disease diagnosis, and 1 from Childhood Education. Comparing these disciplinary sets across Conversations yielded 74 articles debating the substance or functioning of mirror neurons,[13] 27 exploring the role of mirror neurons in speech or sound, 22 exploring how mirror neurons affect/alter emotions more generally, 12 explicitly addressing Autism, 12 addressing the implications of mirror neurons for group research, 10 addressing the implications for robotics,[14] 7 addressing a phenomenological problem of inter-subjectivity, and 7 addressing the implications for therapeutic creativity or therapeutic movement. All of the other Conversation categories yielded less than 6 articles.

These two initial coding procedures—dividing the articles first by discipline and then by Conversation—offers an understanding of where mirror neurons are being discussed and reanimated outside of the neurosciences such that a more detailed textual coding can proceed. Starting this way provides a well-defined sample of texts for a further textual coding that can facilitate a rhetorical exploration of disciplinary animations of mirror neurons. The results suggest that Phenomenology, Robotic Engineering, Group Analysis, and Movement Therapy have a particularly unique relationship with mirror neurons insofar as the articles from those categories do not engage in scientific debates about the empirical aspects of mirror neurons

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[13] This number is calculated by adding up articles covering the debates about empirical nature of mirror neurons, debates about ‘action understanding’ and other neuroscientific explorations into the functioning or location of mirror neurons.

[14] Note: articles with robotics topics also appeared in articles categorized as “Biology” since those disciplinary categories were developed from where the article was published.

but, rather, are having Conversations that seek to use mirror neurons to build new facts, theories, or practices in their own fields. Those articles, when cross-referenced with their disciplinary category codes, offer a sufficiently narrow disciplinary perspective on a field-specific concern being addressed, whereas other Conversation categories span multiple disciplines or address a specific concern largely from within a neuroscientific perspective, as witnessed in the articles on Autism research, making them less suitable for achieving analytic objectives focused on discovering how non-neuroscience disciplines use translation strategies that may be field-specific in nature or unique to the claim being advanced. Consequently, articles from Phenomenology, Group Analysis, Robotic Engineering, and Movement Therapy—27 articles in total—serve as the starting point for the selection of texts. However, since Group Analysis, being a Social Sciences field, provides a strong contrast with the other fields, additional articles not appearing in the SUMMON search were selected for that category. This was done by identifying articles from that field appearing in the sampled articles' bibliographies but not appearing in the results of the SUMMON search. A total of three additional articles were identified and added to the sample. That these articles did not appear in the initial SUMMON search is not surprising since they did not self-describe with the search term "mirror neurons" despite the fact that they have been judged, upon careful reading, to hold significant content about mirror neuron research. The researcher, in this case, made a qualitative judgment that those three additional articles should be included in this study.

After categorizing the 30 articles by home discipline and Conversation, each article was read in full by the researcher. The purpose of reading the articles at this stage was to

make a judgment about the narrowness of the Conversation happening in the field. Articles only nominally addressing a field-specific Conversation were thrown out of the sample. For example, an article in Movement Therapy titled, “The Relationship Between Creativity and Intelligence: A Combined Yogi-Centric Approach” appeared in the text sample and was coded, based on its title and abstract, as using mirror neuron research to inform the field of Movement Therapy; however, upon reading the article, it was not centered on mirror neurons and was ancillary to the field of Movement Therapy. 9 articles, including 4 from Robotics that were cross-coded in Biology, were removed from the sample in an effort to focus the sample.

All in all, then, 21 articles serve as the textual basis for the more detailed coding scheme that will facilitate a discussion of the first analytic objective—what kind of translation strategies appear in each article and across the fields sampled—as well as of the second analytic objective—whether and how different “realities” of mirror neurons appear across different non-neuroscience fields. Exploring these analytic objectives will, subsequently, pave the way for an exploration into the third, fourth, and fifth objectives—mapping out factors related to the argument being advanced in each article, exploring differences across time of publication, as well as considering what can be said about neuro-rhetorical scholarship from the translation strategies observed in those fields.

Segmentation

Prior to the development of a coding scheme, articles are segmented into clauses. The use of the clause, as opposed to a larger unit of segmentation, best enables a micro-analysis of the text wherein each actor for every verb, whether that verb operates as the main verb in a primary clause or the secondary verb in a subordinating clause, can be appropriately evaluated. Although the subjects of clauses are always, in some manner, actors in a text, they do not always reveal all of the actors—actors may, for instance, operate in passive constructions; however, since a quantitative descriptive approach can only count so much and cannot count what does not appear in the text, what is quantified is what the researcher considers qualitatively important. That is, the quantitative descriptive approach is qualitative from the selection of the codes right up through the interpretation of recurring patterns in the text. Accordingly, the codes chosen for this study are intended to outline where and when human and non-human actors lead the discourse as subjects and how those actors are active or not active around the appearance of the terms “brain” and “mirror neurons.” Further, since the study aims to point out how actors are mediating other actors—exercising agency—then a focus on subjects seems beneficial. Thus, the clause unit of segmentation is the most appropriate choice because this unit allows for oft-overlooked subjects and clauses, such as introductory subordinating clauses that effectively frame a sentence and establish relationships to a main clause, to be analyzed for actor-action relationships.

Coding Scheme

For the purposes of clarity and organization, five sets of well-defined research questions explicate the analytic objectives and organize the coding scheme. The first set of questions follows from the first analytic objective and strives to understand how mirror neuron research is "translated" within the local, field-specific context through the positioning of actors that define problems and reassemble the network around actors that can solve those problems. The second set of questions also follows from the first analytic objective insofar as it strives to define how actors are acting, and how strongly, by mapping out verb forms. The third set of questions follows from the second analytic objective, exploring dynamism and connectability—that is, when and where mirror neurons come to mean something qualitatively different and when and where those various expressions of mirror neurons retain connections to neuroscience sources. The fourth set follows from the third analytic objective and examines the strength and direction of each argument as it relates to observed translation strategies. The fifth set follows from the fourth analytic objective and explores how time may make a difference. Ultimately, these research questions organize a qualitative data analysis study that provides a foundation for a rhetorical reading of the inner-workings and stakes of translation processes across these disciplinary texts. The five sets of research questions are as follows:

Set #1 – Research Questions for Code Development – Exploring Actors in the Translation Process

RQ1) Who or what is acting, and how do actors differ across articles?

1a) How are human and non-human actors (neurons, scientists, technologies, etc.) positioned as gate-keepers, as definers of a problem, or as support such that translation strategies can be assessed?

Set #2 – Research Questions for Code Development - Exploring Action and Certainty

RQ1) What kinds of actions (verbs) are mirror neurons, neuron systems, and brains said to do in these articles (absorb, reflect, represent, perform)?

1a) Are the objects of study (brains, mirror neurons, etc.) in the neurosciences made active in subject positions, or are they made passive to be acted upon when they are moved into another field to construct new knowledge? When and where are they active or passive?

2a) Are the verbs associated with brains and mirror neurons qualified or certain?

Set #3 – Research Questions for Code Development - Exploring Dynamism and Network Connectability

RQ1) Which neuroscience sources are cited in these articles, and how do those citations vary across articles?

RQ2) How many neuroscience sources are primary mirror neuron studies and how many are from secondary sources that compile information or comment on it?

RQ3) How often are qualified and the certain statements about mirror neurons cited with a source from the neurosciences? In other words, when are sources enrolled to support qualified versus certain statements?

3a) How do qualifications within statements change across the articles when those statements are placed in reference to individual neuroscience citations? That is, does the enrollment of support change the certainty of claims?

Set #4 – Research Questions for Code Development – Exploring Claim Strength and Direction in Relation to Question Sets #1 and #2.

RQ1) Overall, can arguments be predictive of translation strategies?

RQ1a) Do articles with weaker or stronger certainty in concluding claims use different types of actors (including mirror neurons) in the actor position?

RQ1b) Do articles with weaker or stronger certainty in concluding claims show differences across the type of verb modality (qualified and certain) used when discussing the brain or mirror neurons?

RQ1c) Do articles with supporting or changing directions for their concluding claims use different types of actors (including mirror neurons) in the actor position?

RQ1d) Do articles with supporting or changing directions for their concluding claims show differences across the type of verb-forms (qualified and certain) used when discussing the brain or mirror neurons?

Set #5 – Research Questions for Code Development - Exploring Time

RQ1) Do any of the above research questions vary when time of publication for these articles is taken into account?

Ultimately, to address these sets of research questions, 21 code categories along 3 coding dimensions have been defined and applied to all sampled texts. These codes are shown in Table 3-1.

Table 3-1. Code Categories

1. CITATION DIMENSION					
Code	**MARK ALL NEUROSCIENCE SOURCES AND HOW OFTEN THEY ARE USED**				
Mirror Neuron Studies	Secondary Brain Sciences Sources				
2. ACTOR DIMENSION					
Code	**MARK ACTOR IN SUBJECT POSITION IN CLAUSE**				
A) Brain or specific brain systems other than mirror neurons.	B) Mirror Neurons.	C) Study participants.	D) Collective Human Actors that are non-neuroscientists, out in the world. Does not include study participants.	E) Neuroscientists / researchers in general.	F) Specific researcher by name.

Table 3-1. Continued

G) Technology, including computers and robots or systems.	H) Research, studies, frameworks, experiments, models in general.	I) Disease Diagnosis	J) The Nonhuman Environment, including specific references to things, not including humans or animals or specifically "technological" things.	K) Specific Data or a Computation or Mathematic Calculation.	L) Action done with no reference to specific brain system - includes the word "action," "moving," "activity," i.e. acting in general independent of reference to anatomy.
3. VERB DIMENSION					
Code	**MARK VERB CERTAINTIES FOR BRAIN & MIRROR NEURON ACTOR CATEGORIES ONLY**				
A) Certain Past	B) Certain Present	C) Certain Future	D) Qualified Past	E) Qualified Present	F) Qualified Future
3a. SECOND-PASS ON VERB DIMENSION					
Code	**MARK RECURRING VERBS FOR MIRROR NEURONS ONLY**				

The first coding dimension is designed to track neuroscientific sources cited across all of the articles. The second coding dimension is designed to highlight key actors and how

mirror neurons are organized around and within other actors, showing who/what acts in relation to whom, offering the researcher a numerical base of interested human and nonhuman actors and a place from which to examine how mirror neuron research is situated in lieu of recurring actors. The third coding dimension is designed to highlight the level of certainty the text imbues to actions produced and/or received by mirror neurons, neuron systems, and brains, and then place those certainties in reference to cited clauses, offering the researcher a sense of how mirror neuron research retains connectability to the neurosciences and negotiates network assemblage.

These three code dimensions combined support the first and second analytic objectives because they describe what mirror neurons do, to whom, and with what level of certainty they do it in relation to neuroscience citations, while also describing what other kinds of actors are engaged in the translation process. Such information gives insight into when and where mirror neurons act differently and how citation information is coupled with actors and verb forms to comprise different strategies of translation. Ultimately, these codes facilitate a rhetorical reading of Callon's (1986) "moments of translation."

Further, it should be noted that these codes support the third and fourth analytic objectives as well. In regard to third objective: the codes allow for further investigation into the different kinds of strengths and directions of claims being advanced by marking how actors are associated or disassociated with those concluding claims. In regard to the fourth objective: time of publication for all articles will be documented and analyzed in reference to the outcome of the other code categories, thereby addressing that objective.

In addition, the fifth analytic objective is also supported by these codes because it is designed as a qualitative evaluation of the lessons learned after all of the code categories have been applied and after the rhetorical analysis of specific characteristic examples of translation strategies and their corresponding "moments of translation" (Callon, 1986) has been undertaken. Ultimately, the fifth analytic objective is premised upon the notion that rhetorical scholarship and scientific practice both entail "rhetorical stylizing, organizing, and presenting data" (Prelli, 1989, p. 258); from this perspective, the fifth analytic objective views all fields as claim-makers seeking logical coherence and, therefore, assumes rhetoric is in need of translation processes that can be adequately described by the code categories designed from the first four analytic objectives. The fifth objective, in other words, pursues a reflection on how other disciplines stylize, organize, re-create, and make "real" neuroscience in their own domains and carries the expectation that rhetoric can learn from these examples and is not so unique that any lessons learned will be unusable. As will be evident in future chapters, rhetoric can look to these disciplines to better theorize its own engagement with the neurosciences.

CHAPTER 4:

RESULTS FROM THE TEXTUAL ANALYSIS

Chapter 3 developed five research questions designed to investigate why four "outside" disciplines turn to the neurosciences and how they animate mirror neuron research in their own field-specific journals. Those five research questions include: 1) who or what is acting in the sampled journal articles; 2) what do brains and mirror neurons do in the articles; 3) which neuroscience sources are used, where, and how often; 4) what kinds of arguments are being made and how certain are those arguments; 5) does the time of publication effect the data? This chapter details the code occurrences and argument types across these research questions in order to explore Actor-Network Theory "moments of translation" (Callon, 1986) occurring within the fields. Together, the coded data and the argument analysis suggest recurring discursive features in and across fields that point toward specific translational processes.

Ultimately, this chapter sets the stage for a discussion in Chapter 5 about how recurring discursive features indicate translational processes used by academic fields to re-make their worlds. Chapter 5 shows how the neurosciences participate in constructing a framework for each field's stability or change amid contests over meaning, legitimacy, and power. In the end, Chapter 5 uses the data analysis from this chapter to identify specific examples from the text and show how translational processes occur and significantly alter the

interpretation of "mirror neurons."[15] This is done to understand the "reality" of mirror neurons in different fields and to grapple with the idea of conducting a "neuroscience of X-field," which must contend with multiple ontologies of mirror neurons.

Actors Across Fields

What immediately stands out from the coded data are divergences in the human-actor codes versus non-human actor codes across fields.[16] The fields that regularly position people, such as specific researchers or study participants, as the acting subject in the clause are not the fields that regularly position non-human actors, such as technologies or data. For instance, the field of Group Analysis is heavily human-centric, with 20% of all coded clauses in that field (N=204) naming specific researchers in the actor position and 24% (N=151) referencing un-named people. Similarly, the field of Movement Therapy positions the bodies of specific study participants 25% (N=314) of the time in the actor position and a specific researcher 9% (N=115) of the time. Compared to a field like Robotics, those same codes categories represent 2% to 3% respectively. Phenomenology resides somewhere in the middle, having 23% (N=320) of actors referring to specific researchers while also using research studies as actors 19% (N=242) of the time, more than any other field. Figure 4.1 shows totals of human and nonhuman actors across all fields, and Figure 4.2 shows divergences in specific actor codes.

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[15] Citing Connell & Galasinski 1998 and Kelly-Holmes 1998, Brent Faber (2007) uses the phrase "change entails contests for meaning, legitimacy, and power" (p. 27). The phrase is repeated here and made applicable to this context.

[16] The data represents 5,024 coded clauses from 21 articles with each of the four fields of study having an average of 1,256 coded clauses each.

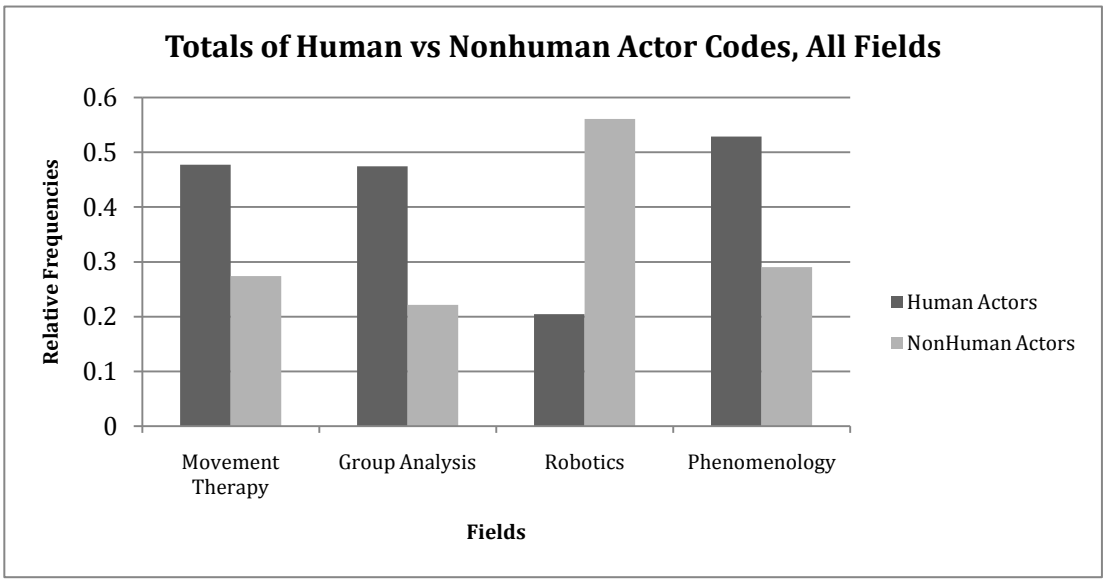

Figure 4-1. Totals: Human vs Nonhuman Actor Codes

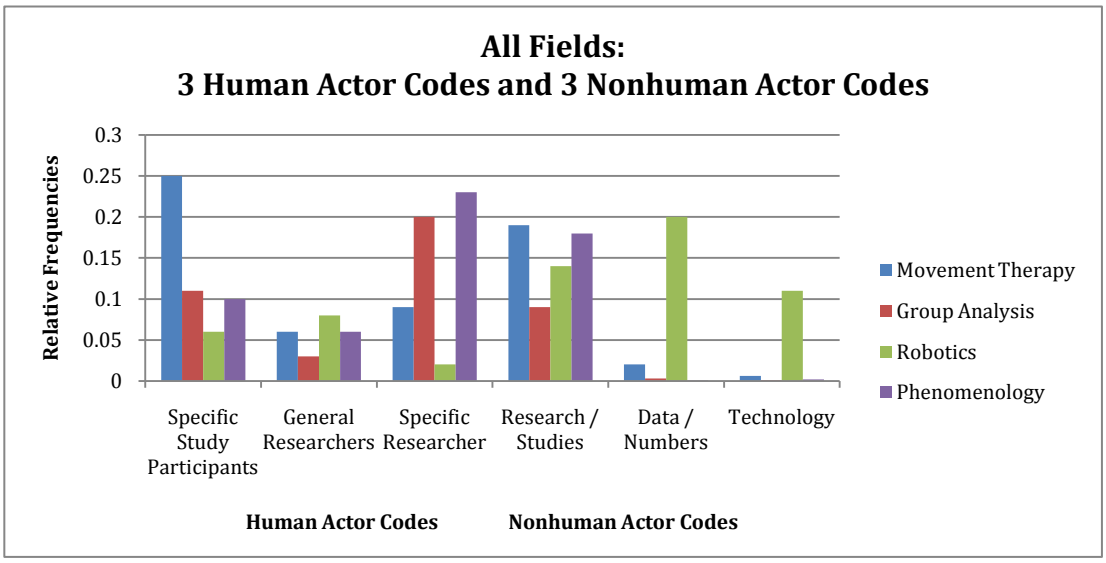

Figure 4-2. Comparison of Selected Human and Nonhuman Actor Codes

As seen in Figure 4.2, differences in the data occur within the "non-human" actor codes. The field of Phenomenology centers specific research studies as actors in a clause 18% (N=242) of the time. This stands in sharp contrast to Group Analysis, which uses that same actor code 9% (N= 90) of the time. In a similar divergence in the data, Robotics positions raw data as the actor in the clause 20% (N=276) of the time and a specific technology as the actor 11% (N=156); however, no other field uses data as an actor more than 2% or a technology as an actor even 1%. Thus, if the four fields were arranged on a scale running from "human-centric" to "non-human-centric" in terms of recurring actors, the scale would move from Group Analysis to Movement Therapy and Phenomenology to Robotics.

The "human" versus "nonhuman" actor codes prove interesting when compared to how often each field uses brain systems and mirror neurons as a clausal actor. Combining those two "brain code" categories, Group Analysis uses them 17% (N=183), Movement Therapy 13% (N=172), Robotics 9% (N=128), and Phenomenology 8% (N=117). Those differences across fields are roughly the same when the code categories of "mirror neurons" and "the brain" are divided and examined individually.[17] A chi-squared analysis between total human-actor codes and brain-actor codes, across all fields, shows a .001 significance level, and when only mirror neuron actor codes are tested against total human-actor codes, a significance level of .0007. Thus, the data suggests significant correlation between the employment of human actors and specific references to the brain. In fact, the fields of Group

[17] "The brain" as actor is used between 4%-10% and "mirror neurons" between 3%-7% percent respectively. The data become more revealing when these code categories are combined, as discussed in the paragraph.

Analysis and Movement Therapy together use the brain or mirror neurons as an actor 30% of the time and use non-human actors 49% of the time;[18] Phenomenology and Robotics, by contrast, together use the brain or mirror neurons as an actor 18% of the time and use non-human actors 85% of the time. Thus, roughly twice as many non-human actors would, one might expect from this data set, lead to half as many discussions of "the brain" or "mirror neurons" in any given article. Put differently, it seems that "the brain" and "mirror neurons" are prone to be organizing factors in a discourse led by humans and individual researchers. In fact, the data suggests that Group Analysis and Movement Therapy may be using these code categories as what Latour (1987) calls "spokespersons" for the field, treating "the brain" and "mirror neurons" as hardened and "black-boxed" entities that do some work in the argumentation (p. 71-73). This will be explored in Chapter 5.

Brain Actions Across Fields

The second research question concerns what "the brain" and "mirror neuron" actors are doing and how strongly they are doing it. This research question is designed to better understand how the central object of study—mirror neurons—is situated in these other fields and whether the statements made about them are definitive and whether they require citation support. The analytic objective here is to start to explore what kind of roles brain-actors are taking up in the new network and to see to what extent they carry over actors from the neuroscientific community as a scaffold of support through citations. This will serve to

[18] Human actor codes include: subject participants, general human actors, general researchers, specific researchers, and actions done by humans. Non-human actor codes include: diseases, research studies, research processes, environmental objects, data/numbers, and technologies.

expose translational processes to the extent that recurrence of these brain-actors indicates how big the new network must grow to become persuasive and whether the discursive construction of the field as a new network requires rearrangement around brain-actors.

Looking at uses of mirror neurons across all fields it is easy to see that they are placed into the actor position not because they act in very significant ways but because they need, for one reason or another, to occupy the subject position—to take center stage—in the discourse. In other words, mirror neurons only act in active sentence constructions with action verbs between 13% and 17% of the time; they are primarily used with the verb "to be" as authors repeatedly explain that "mirror neurons are X." This indicates that these actors are standing in for a reality that they only nominally represent in the neurosciences, suggesting a translational process at work here. In other words, saying that these actors "are X" indicates instances of a "positive modality" or, as Latour (1987) puts it, "those sentences that lead a statement away from its conditions of production, making it solid enough to render some other consequences necessary" (p. 23). The tendency for mirror neurons not to act even when in the actor position can be seen in Table 4.1, which shows total uses of mirror neurons in the actor position across all fields against the number of times mirror neurons exist in an action verb construction or in a Be-verb or in a "have/been" construction.

Table 4-1. Mirror Neuron Verbs: Total Uses Across Action Verb Uses

	Mirror Neuron as Actor: Total Uses	Mirror Neuron as Actor: Used with Action Verbs	Mirror Neuron as Actor: Used with Non-Action Verb Constructions
Group Analysis	78	14	64
Movement Therapy	66	18	48
Phenomenology	52	16	36
Robotics	65	9	56

The possibility that a lack of action verbs reveals instances of a positive modality is heightened considerably when compared to the way neuroscience sources about mirror neurons use those same actors as active, pairing them with action verbs. That is, since a negative modality is when a statement leads “towards its conditions of production” (Latour, 1987, p. 23), sources failing to explain how mirror neurons act promote a positive modality, contrasting with treatments of mirror neurons in the neuroscience. Indeed, taking the most commonly cited neuroscience article across all fields and applying the same codes offers some preliminary indication of the “negative modality” associated with mirror neurons within the neurosciences.

For example, in the article, “Action recognition in the premotor cortex” by Vittorio Gallese and colleagues (1996), the term “mirror neuron” is used in the actor position 14

times. Only one time is it used without an action verb; mirror neurons respond, activate, provide, generate, and fire. If they "are" anything, then they "are specific in terms of motor activity" tested by these researchers (p. 602). Consequently, if this article is any indicator, then mirror neurons in the most commonly cited neuroscience articles used in the text sample are still under a burden of proof, under contestation; mirror neurons remain under discussion, not yet solidified in their ontology. However, this is not always the case in the discourse in the sampled articles from other disciplines.

Although there is no discernable pattern among action verbs associated with mirror neurons in the different sampled articles, the few action verbs that do appear seem to position mirror neurons as being passive or having a passive quality. For example, the most commonly used action verbs are as follows: discharge, connect, fire, and represent. Actions verbs not already listed and used more than two times include: allow, encode, play, respond, reveal, and tell. With the exception of "fire" and "encode"—although these actions may be compelled by other forces as in the phrase "mirror neurons fire in response to visual perceptions"—the verbs here seem to position neurons as passive responders. What this indicates, perhaps, is that what mirror neurons do is significant not because they act *on* us but because they act *within* us as a communicative system that discharges, connects, fires, etc., working as machinery of the mind. But even more to the point, mirror neurons are primarily significant in these articles because of what they *are*; that they *are* mirror neurons because of what they do seems tangential here when one considers how often mirror neurons "are" versus how often they are said to do something. This heightened emphasis on "are" presents mirror neurons as an undeniable materiality that establishes a solidified ontology of the body

useful for making field-specific arguments. Another way of saying this is that the grammatical shift points to a translational process where mirror neurons become actors that make the body's mechanisms stable, understood, and evidence for some argument.

Figure 4.3 visualizes claims about mirror neurons and the brain in terms of the certainty of those claims. The figure shows the number of times the brain or mirror neurons are positioned as the actor in the clause[19] and places those instances in cross-reference to their expression as certain or as qualified. The figure then shows how often certain and qualified phrases appear with citations. For example, the verb form "does show" would be coded present-certain while the verb form "could suggest" would be coded present-qualified, and each would then receive an additional code if the clausal segment contained a citation. The following figure visualizes these data.

[19] Past tense clauses yielded nominal results but showed similar divergences. For example, Group Analysis cited 5 of 6 past tense clauses where the brain or mirror neurons was used as the actor in the past tense, and Robotics only cited 5 of 10 instances.

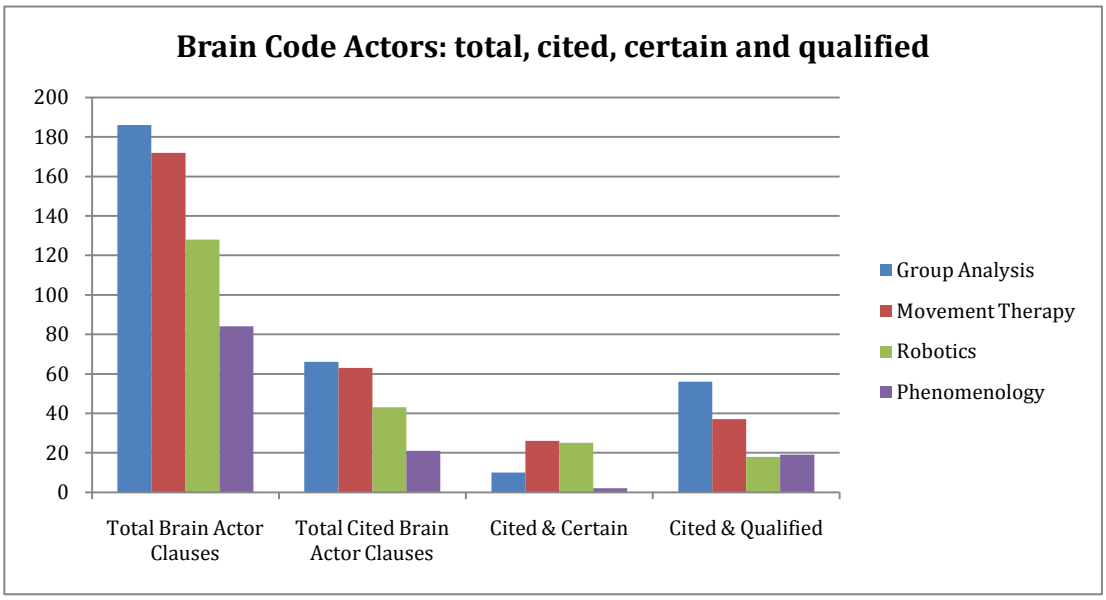

Figure 4-3. Brain Actor Codes: Cited Clauses By Certain and Qualified Clauses

The data indicates that, overall, citations appear next to about one-fifth to one-third of statements about the brain when the brain or some part of it is acting in a clause. Looking across fields, Phenomenology shows a lower tendency to qualify statements and an overall lower tendency to cite statements about the brain. That field cites brain-as-actor clauses a total of 25% (N=21) of the time but qualifies those statements only 17% (N=19) of the time. This represents a low citation rate in this data set and low rate of verb qualification, indicating that clauses about the brain or brain systems are certain in Phenomenology 83% of the time. Robotics displays a similar pattern, citing clauses 36% (N=43) of the time and qualifying them 16% (N=18) of the time. This represents a typical citation rate but a low rate of qualification, again showing certainty in the field. The Group Analysis data provides a good contrast. That field cites clauses at almost exactly the same rate as Robotics (35% / N=66), yet it qualifies those statements 43% (N=56) of the time, nearly three times as often.

Movement Therapy shows a typical rate of citation 37% (N=21) but looks a bit more like Group Analysis in terms of how often the field qualifies clauses about the brain or mirror neurons (27% / N=19). The same relationships prove true in the percentages of qualified clauses among the total percentage of un-cited clauses—Group Analysis and Movement Therapy qualify more often. Table 4.2 shows these relationships.

Table 4-2. Total Cited and Uncited Clauses Across Qualified Clauses

	% of Cited Clauses	% of Qualified Among Cited Clauses	% of Uncited Clauses	% of Qualified Among Uncited Clauses
Movement Therapy	37%	27%	63%	22%
Group Analysis	35%	43%	65%	29%
Robotics	36%	16%	66%	12%
Phenomenology	25%	17%	75%	14%

Tests of statistical significance support the observation that there are significant differences in qualified clauses across fields. Chi-square analysis reveals a p-value of .06 when the totals for brain actor clauses in all fields are calculated against the totals for qualified clauses in all fields. In fact, Group Analysis shows a positive deviation of .24% in the total number of qualified clauses when compared to the expected value; similarly, Robotics shows a negative deviation of 34.6% in that same category. Thus, there is confidence in asserting that Group Analysis and Robotics deviate in a significant way in terms of the amount of qualification used and not used.

The data in many ways parallel that obtained from charting clausal actors when those actors are grouped as human and non-human. In other words, human-centric fields cite clauses about the brain more often and qualify their statements more often; non-human-

centric fields cite those same kinds of clauses less often and tend not to qualify their statements. This indicates the complexity of the translation process, suggesting ultimately that there is a tendency toward certainty when humans are not discursively involved. Thus, when a field like Robotics or Phenomenology turn mirror neurons into a computation or into an argument that proceeds without reference to specific humans, the citations drop away and the new entity becomes a strong actor that moves with certainty. However, when human actors lead the discussion, the overall discourse remains locked in observation and opinion, indicating that mirror neurons do not re-arrange the network very much or do very much new work in those fields. Indeed, the next chapter will show this to be the case in both Group Analysis and Movement Therapy and will explore how mirror neurons "are X" in a human-centric discourse because of the way highly-networked human actors declare they "are X," not because the mirror neuron becomes a different kind of actor like a computation or an argument, as in Robotics or Phenomenology.

Neuroscience Sources

Across all articles, there were 230 unique neuroscience sources cited. What proves immediately striking about this number is the fact that only two of those sources were shared in common by all fields of study. Only six were shared in common by three of the four fields.

Those sources cited by all of the fields include "Rizzolatti, Fogassi and Gallese, 2001" and "Gallese, Fadiga, Fogassi, and Rizzolatti, 1996." The 1996 article is one of the earlier major publications presenting mirror neuron research to the neuroscientific community. Thus, it may not be so surprising to see it re-used so often. The repetition of the

2001 article, however, might seem like somewhat of a surprise given the fact that all of the researchers given credit for writing that article wrote about mirror neurons numerous other times before and after 2001; yet, that source, "Neurophysiological mechanisms underlying the understanding and imitation of action," from *Nature Reviews Neuroscience*, argues strongly for mirror neurons as the biological mechanism that explains how humans can comprehend the actions of others through a direct simulation of motor movements in the brain. Interestingly, this article appears in the "Opinions" section of *Nature Reviews Neuroscience*, a fact that seems to lend it license to speculate about the meaning of mirror neurons and, perhaps, make it more prone to uptake across non-neuroscience fields looking to use and apply mirror neurons to their own concerns.

Seeing the original 1996 article on mirror neurons appear across all fields is to be expected. However, the presence of 230 possible brain sciences articles to choose from indicates that each field, by and large, turns to different sources and that each field may, in fact, be able to pick and choose which mirror neuron sources it can, wants, or needs to cite. To some extent, this lends support to the discussion in Chapter 2 about uses of neuroscience becoming multiple and varied as controversy and discussion expand both within the neurosciences and out across disciplines. Of course, the divergence in sources might indicate just how different kinds of brain science sources are needed to achieve different kinds of field-specific arguments. Determining what is happening here in Chapter 5 through a close rhetorical analysis will address Analytic Objective 2, which is designed to understand how citations are deployed as support for an argument and how mirror neurons are depicted through different citations, enabling different field-specific arguments; Chapter 5 will seek to

address, amid the discussion of each field's translational processes, why different fields use different amounts and kinds of sources.

Nevertheless, at the moment, the data reveals 99 of the 230 brain science sources cited in the sample are specifically mirror neuron studies, as opposed to other kinds of brain studies applying mirror neuron findings or commenting on the finding or exploring related processes in the brain. All 6 sources shared in common by three or more fields fit into this "mirror neuron study" category.

Lack of overlap between citations across fields can be examined in more detail when the data is spliced by how often a single field cites a single source more than 3 times and then by how often those re-appearing sources emerge in other fields. Because many sources appear only once or twice in a particular set of articles from the same field, looking at regularly recurring sources in a field and their presence or lack of presence in another fields offers further insight into the differences between fields. For example, when looking across all possible brain sciences sources, articles in Movement Therapy cited 15 sources more than three times and used 13 of those sources 75-100% more often than any other field. Robotics cited 12 sources more than three times and used 11 of those 75-100% more often. Phenomenology only cited 4 articles more than three times and used 3 of those 75-100% more often. Finally, Group Analysis cited 7 sources more than three times and used them all 75-100% more often. What this indicates is quite a lot of field-specific reliance on different sets of brain science sources.

The reliance on a defined set of sources unique to each field can be better understood when sources used more than three times are placed in reference to how often each field cites any given brain science source. Table 4.3 details how many unique sources from all brain science categories each field uses in total and then shows them in comparison to how many sources each field uses more than three times. Sources used more than 3 times are termed "reliant source citations."

Table 4-3. Source Rates and Reliant Source Rates Across All Fields

	Robotics	Group Analysis	Movement Therapy	Phenomenology
Total Sources Used	81	49	80	46
Reliant Sources Used	12	7	15	4
Percentage of Reliant Sources	15%	14%	19%	9%

This data suggests that the fields of Robotics, Group Analysis, and Movement Therapy have a limited, coherent set of brain science sources from which researchers working in those fields draw but that Phenomenology shows little coherence in commonly cited sources. In other words, all articles, when discussing mirror neurons, appeal to some extent to different brain science sources; each article is less likely to turn to the same sources as another in that same field even though each article sampled is exploring the potential of

mirror neurons while engaging in the same general disciplinary conversation.[20] On the face of it, this might suggest that the sampled articles from Group Analysis or Phenomenology are doing less translational work since they draw on less sources and have the greatest divergence in the sources that they choose. Then again, when one looks not only at the percentage of sources used and the percentage of reliant sources but also at the *type* of sources used, the data reveal that Group Analysis and Movement Therapy rely heavily upon secondary brain science sources and cite those sources more often than any other field. Thus, it is more likely that the *type* of sources fields choose, taken in conjunction with the total number of sources used, are better indicators of the pulling apart or the holding together of the actor-network that is "mirror neurons" and "the neurosciences" in that field. Put simply, since secondary sources are not dealing directly with mirror neuron studies, when fields use few sources and rely on secondary sources, they are likely already treating the neuroscience finding as a networked and solidified actor keeping all negative modalities at bay—keeping the black-box closed, in other words. Examples of distanced sources include Antonio Damasio's *The Feeling of What Happens, Body and Emotion in the Making of Consciousness* from 1999 and Thomas Metzinger's *The Ego Tunnel: The Science of the Mind and the Myth of the Self* from 2009.

The data reveal that some fields turn more often to mirror neuron studies closer to the neuroscience actors that develop claims about mirror neurons while other fields turn more often to secondary sources rehearsing or building upon such claims. Table 4.4 shows total sources used and then breaks that number down into "close" sources and "distanced" sources.

[20] See Chapter Three's discussion of Sampling Method and Conversation Analysis.

“Close sources” refer to the 99 mirror neuron studies, and “distanced sources” refer to all other coded brain science sources. The following Table, 4.5, shows the total number of citations used in each field—as opposed to the total number of unique, individual source texts—against citations of “close sources” and citations of “distanced sources.”

Table 4-4. Total Sources By Percentage of “Close” and “Distanced” Sources

	Group Analysis	Movement Therapy	Phenomenology	Robotics
Total Sources Used	N=49 / 100%	N=80 / 100%	N=46 / 100%	N=81/ 100%
Close Mirror Neuron Sources	35%	34%	76%	49%
Distanced Sources	67%	66%	24%	51%

Table 4-5. Total Citation Occurrence By Percentage of “Close” and Distanced” Citations

	Group Analysis	Movement Therapy	Phenomenology	Robotics
Total Citations Used	N=89 / 100%	N=200 / 100%	N=66 / 100%	N=168 / 100%
Close Mirror Neuron Citations	52%	32%	74%	56%
Distanced Citations	48%	68%	26%	44%

These data suggest correlation between fields organizing discourse around human-centric actors and fields using “distanced” brain science sources. In other words, there may be a translational process at work here that occurs when human actors organize the network—brains and mirror neurons get discussed through secondary sources that have already interpreted their meaning. The disciplinary discourse convention of talking about individual researchers and their work—as is common in Group Analysis and Movement Therapy—does not seem to lend itself to making inferences about what the neuroscience means from the original studies. Human actors, rather, are discussing what other human actors have already said about those studies. In contrast, fields like Phenomenology and Robotics, which tend overall to be less human-centric in terms of their disciplinary discourse conventions, turn to mirror neuron studies more exclusively because data and arguments are the focus of those sources. Disciplinary discourse conventions align in these cases such that interpretation of what mirror neurons do for the field of Robotics and Phenomenology is

drawn largely from making inferences from the data or the logical proof, not from pre-existing conversations. Thus, it may be little surprise that Group Analysis and Movement Therapy are citing clauses about the brain more often and are qualifying those claims more often; when writing about what other researchers have said and citing secondary sources, qualified claims follow in ways that they do not when writing about what neuroscientists have said in their original studies through their data.

It should also be noted that citations used in common across all fields happens more often with older mirror neuron studies. This can be seen by considering how the 6 sources shared by 3 of the 4 fields sampled all pre-date 2001 with 4 of the 6 sources pre-dating 1998. In fact, in Phenomenology and Robotics all sources used at least three times and used most frequently in those fields pre-date 2005. Indeed, only 3 out of 37 sources across all fields and used 3 times or more were written after 2007. This occurs despite the fact that the articles sampled for the data analysis were all written between 2001-2010 with three of the four fields of study having at least one representative from 2010 but only one field having just one source older than 2004. In short, the data suggests that these fields are all, to some extent, lagging behind the current trends in neuroscientific research, or they are turning to older, established neuroscience sources most regularly because those are the sources that “discover” the mirror neuron; however, the older mirror neuron sources have, since then, been called into question and refined, so when fields rely primarily upon older sources, they are more likely to develop an out-dated conception of mirror neurons. Further, reliance on older sources may indicate a translational process where pointing to the existence of mirror neurons is more important for re-making the network of a field than getting into much detail

about the function and existence of mirror neurons. Such is the case to a greater degree in both Group Analysis and Movement Therapy. This issue is addressed in the next chapter.

Overall, the 4 fields in this text sample appeal to all kinds of mirror neuron sources, appeal in some cases to sources used exclusively by them, and only appeal to sources shared in common by other non-neuroscience fields when those sources are the older or original founding sources that establish the finding in the neuroscientific community. In other words, the newest mirror neuron research appears to be unevenly dispersed across fields or simply non-existent.

Argument Analysis

The third research question developed for this dissertation asks what kinds of arguments are being made in these articles and how often they are expressed with certainty. The analytic objective informing this research question is whether different kinds of arguments tend to require different translational processes or whether an engagement with the neurosciences across the disciplines shows common patterns. Arguments were mapped by locating the concluding claim of each article and using Toulmin's three categories for differing strengths (certainty) of a claim, cross-referencing those strengths against the direction of the claim; the "direction" refers to how much the claim seeks to do in terms of re-writing the field's established theories and practices and is shown as a range stretching from "support of existing theories and practices" to "abandonment of existing theories and practices." Table 4.6 shows all articles mapped on a grid that juxtaposes strength of claim against direction of claim.

Table 4-6. Strength of Claim By Direction of Claim – All Fields

21 Articles	Strong	Mildly Qualified	Qualified
	"Does" Claim	"Most Likely" Claim	"Might" Claim
Should abandon existing theory or practice	1	0	0
Should re-direct theory or practice	4	1	0
Can extend existing of theory or practice w/o changing approach / principles	4	2	2
Supports existing theory or practice	7	0	0

Taken together, the chart offers a good idea of what these different fields attempt to do with the neuroscience research about mirror neurons and how they seek to establish the realities of their fields in reference to that research. Seven, or one-third of all articles, seek to support their fields' existing theories and practices, asserting that mirror neurons can do this work. Eight seek to extend some existing theory or practice through appeals to mirror neuron research while four of those show some hesitation in doing this. Six other articles attempt to argue that mirror neurons indicate reason to re-direct a theory or practice, and those articles express a bit more confidence in making the claim. Only one article calls for the abandonment of existing theory and practice in light of mirror neuron research and does so with certainty. It should be noted that any article coded as "re-directing" theory or practice does not outright reject existing theories or practices of the field but suggests the need for brand new approaches; this differs from "extending" existing theory or practice, which adds

to a standard conceptual or methodological model. Table 4.7 breaks down each article from each field and shows field-specific differences across these categories.

Table 4-7. Field-Specific Argument Analysis – Strength of Claim By Direction of Claim

	GROUP ANALYSIS			**MOVEMENT THERAPY**		
	"Does" Claim	"Most Likely" Claim	"Might" Claim	"Does" Claim	"Most Likely" Claim	"Might" Claim
Should abandon existing theory or practice	0	0	0	0	0	0
Should re-direct theory or practice	0	0	0	1	0	0
Can extend existing of theory or practice w/o changing approach / principles	1	1	0	0	1	1
Supports existing theory or practice	3	0	0	2	0	0
	PHENOMENOLOGY			**ROBOTICS**		
	"Does" Claim	"Most Likely" Claim	"Might" Claim	"Does" Claim	"Most Likely" Claim	"Might" Claim
Should abandon existing theory or practice	0	0	0	1	0	0

Table 4-7. Continued

Should re-direct theory or practice	2	0	0	1	1	0
Can extend existing of theory or practice w/o changing approach / principles	1	0	0	2	0	1
Supports existing theory or practice	2	0	0	0	0	0

In Group Analysis, 4 out of 5 articles make certain arguments while no articles call for significant change in theory or practice. The articles in this field almost exclusively appeal to mirror neuron research as support for existing theories and practices. They suggest that the practices and outcomes of Group Psychotherapy are supported and legitimized by this neuroscience research. Thus, it is interesting to note that the concluding claims—which guide the coding here—stand a bit at odds with the body of these texts since the Group Analysis articles, overall, use more qualified clauses. As discussed in the next chapter, the conclusions of the arguments are made certain even though the connections explored up to the point of the conclusion are qualified as researchers negotiate neuroscience research with care.

Phenomenology and Movement Therapy are split in terms of suggesting changes. Phenomenology has 5 out of 5 articles making certain claims while 3 of them—those appearing in the bottom half of the chart—seek not to change existing theories or practices. Two articles elucidate how mirror neuron research points to the correctness of existing phenomenological concepts while others seek to use that research in reference to

phenomenological concepts, engaging in struggles over who is right about descriptions of human perception and how phenomenologists should respond to mirror neurons. The field is split insofar as mirror neurons are something to be discussed and taken seriously but also something to be compared to phenomenological history and called into question. Similarly, Movement Therapy has 4 of 5 articles on the bottom "support" half of the chart, while 2 of the 5 qualify their claims, expressing a "wait and see" attitude about the contribution of mirror neurons to the development of therapies, which are largely developed for the easement of difficult or problematic mental states through dance. Robotics, however, has 3 of 6 in the top half of the chart and no articles in the "support" column, suggesting a stronger tendency than any other field to overturn existing theories and practices in Robotics. This should not be entirely surprising, however, since Robotics is an engineering field; the development of advanced or new robotics systems is the aim of most of the sampled articles, so the numbers are not entirely unexpected. Additionally, the fact that two of six Robotics articles qualify their arguments is consistent with the experiments and systems tested in those articles, some showing more conclusive results than others.

What might be said from this general overview of arguments is that fields seeking change through the neurosciences use more sources and citations than those seeking stability. They enroll a larger network of support to achieve this end although Robotics and Movement Therapy—the two fields with the highest rates of neuroscience citations—turn variously to original, core mirror neuron sources and secondary sources and seem to do so because of their disciplinary history and writing conventions, an issue explored in the close rhetorical analysis in Chapter 5.

Time of Publication

The fifth research question deals with whether time of publication effects the actors leading the discussion, the citation practices, or the arguments being made.

The earliest article in the sample is from 2001. The most recent is from 2010. As detailed in Chapter 2, mirror neuron research shifted somewhat around 2001 with the publication of the Umiltà et al. study, which showed that mirror neurons only respond in reference to particular goals, not in reference to any given action at any time. In addition, Wicker et al. (2003) and Krolak-Salmon et al. (2003) conducted highly publicized mirror neuron studies in regard to emotional responses that might have expanded the perceived scope of the importance of mirror neurons. If these studies are taken as landmarks, then articles written prior to this early 2000s time frame when mirror neurons were not yet publicized as limited to goal-specific actions and not yet well-correlated to emotional responses may show some differences in their claims in these specific ways.

In addition, not until 2005 did a whole series of articles emerge skeptical of the interpretation of mirror neurons as “mirroring” other people’s actions or skeptical of the very existence of mirror neurons in humans. Articles by Cisbra (2005), Jacob (2008), Turella et al. (2009), Lingnau et al. (2009), and Decety (2010) are all skeptical of mirror neurons and should all be taken into account when considering the arguments made in articles published both after and prior to 2005. This means considering when the skeptical articles go unmentioned as well as when they were unable to be mentioned. This awareness of what is missing informs the construction of the ontologies of mirror neurons in that it illuminates

what Ann Marie Mol (2002) calls the way "one reality wins" (p. 55). What mirror neurons *are* is largely dependent on what sources one chooses and when those sources were first published. Further, seeing what is left out is tantamount, as Philip Wander (1984) has argued, to ignorance or endorsement and is participatory in constructing a perspective (p. 197).

In reference to the number of sources and types of sources over time, a temporal analysis shows some statistically significant correlations. For instance, if the articles are divided by date of publication, separating articles published in 2010 (N=6) from all articles published on or before 2004 (N=4) and leaving out sources published between 2005-2009 (N=11), then those later 2010 articles clearly use more sources (38% / N=191) than the earlier ones from 2004 or before (17% / N=85). If the number of secondary, non-mirror neuron study sources are specifically isolated here, then it is easy to see that articles published in 2010 deploy those secondary sources at a rate of 11% (N=53) against the total number of sources while articles published on or before 2004 deploy them at 5% (N=25). On average, then, each article from 2010 uses 8.8 secondary sources and those from 2004 or prior use 6.5. Fisher's Exact Test for statistical significance shows good significance—.37—when the two categories tested are the two different dates of publication (2010 and 2004) and the single variable is the total number of sources used in these sets (85 and 191). The same test shows good significance at .42 for the number of secondary sources used as a variable against the number of articles in each set.[21]

[21] Note: Fisher's Exact Test has different levels and standards for significance because it is used in cases when there are few data elements and variables.

In brief, the statistics reveal the way articles, over time, increase the number of secondary sources they incorporate into their constructions even though the number of mirror neuron studies also increases overall over time, from a rate of 12% (N=60) in sources dating at least as far back as 2004 and 28% (N=138) in 2010 sources. However, when looking across all of the articles in the entire sample and not segregating 2004 articles from 2010 articles, the number of mirror neuron studies grows initially and then drops off slightly. But this is not the case for secondary sources. For example, 64 mirror neuron sources are cited before 2004 and only 34 sources are cited after that with a majority of sources appearing between 1998 and 2002. Figure 4.4 demonstrates these relationships. And Figure 4.5 shows how a different pattern—one of growth—emerges when secondary sources are also mapped over those same periods of time.

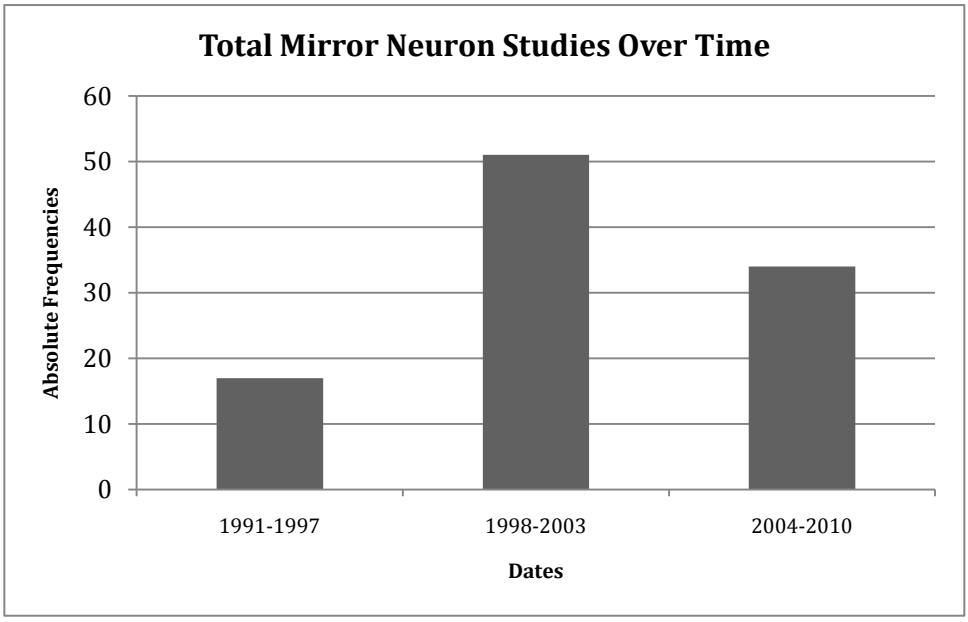

Figure 4-4. Mirror Neuron Sources Over Time

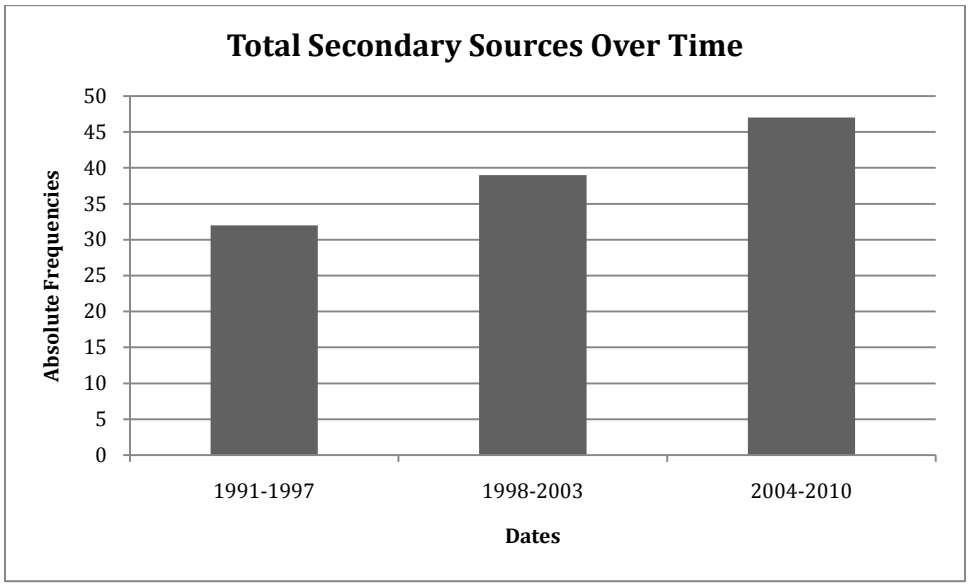

Figure 4-5. Secondary Brain Sciences Sources Over Time

Ultimately, the data analysis points toward a translational process, indicating a hardening of the reality of mirror neurons over time even while there is a sizable increase in discussions about them. Put simply, all fields use more sources over time and, if these data proves to be reliable indicators, then they all seem to edge toward a positive modality around mirror neurons as time progresses, making the biological entity of mirror neurons more easily transferable and stable.

Cross Correlations of Actors Used and Arguments Made

In total, six of the 21 articles argue for changes in theory or practice. This means they suggest changes in their fields. If one specifically looks at those articles, they are unevenly reliant upon non-human actors and general, non-specific human actors. For instance, those

articles—only 28% of the data set—constitute 49% (N=156) of the data actors, 47% (N=139) of the general researcher actors, and 46% (N=115) of the technology actors. Moreover, if one looks more broadly at the 14 of the 21 articles that move in the direction of suggesting any kind of changes or revisions to existing theories or practices—those appearing in the top three-quarters of argument analysis Table 4.6—the heavy reliance on non-human actors grows more prominent.

Articles arguing for change in their fields use 98% (N=251) of the technology actors, 85% (N=114) of the environmental actors, and 94% (N=316) of the data actors. Six out of 14 of those articles are from Robotics, but each field has at least 2 representative articles in this category; consequently, it is not fully expected that these non-human actors would appear in such large quantities here. In addition, it is important to note that the articles making radical suggestions for change use lower than expected numbers of references to the brain and mirror neurons as actors. For example, the 6 articles in the top half of Table 4.6 use the brain as an actor 21% (N=71) of the time and mirror neurons 22% (N=59) of the time, when one might expect that number to be equitable to the percentage of the data set those articles represent, i.e. 28%. Put another way, articles showing some level of support for existing theories or practices in their fields position the brain or mirror neurons as actors more than three-quarters of the time. Appeals to “the brain,” presumably, do some of the support work. Additionally, those articles supporting existing theories or practices tend to be “human-centric” in the way they organize the discourse, suggesting that Humanistic fields like Group Analysis and Movement Therapy, which have traditionally relied upon first-hand reporting styles in their writing practices, may need to explain “the brain” and “mirror neurons” more thoroughly or

discuss them more often in order to evidence their work. In contrast, those fields familiar with data, such as Robotics, speak through data and extend their work through data, while those familiar with concepts and arguments, such as Phenomenology, focus on concepts and end up alternating between human and non-human actors in an effort to adopt and re-consider mirror neurons findings.

In brief, the argument analysis suggests correlation between direction of claim and the types of actors likely to be employed. The more radical and subversive an article's argument gets with respect to its own field's theories or practices, the more likely it will situate general researchers, studies, technologies and data as actors and avoid using brains and mirror neurons as actors. And this makes sense because those actors—data, technologies, and appeals to "research" and "researchers"—are stronger actors in the sense that their networks are naturalized and not called into question in fields that use them, like Robotics and Phenomenology. Brains and mirror neurons are, perhaps, weaker actors unable, in these contexts, to do the argumentative work, but once transformed into data or put into alignment with existing technologies or researchers, are, in fact, able to do argumentative work.

This observation, though, should be weighed against each field's unique disciplinary expectations and writing conventions. In brief, in some cases an emphasis on "brains" and mirror neurons" work effectively—mostly in cases when fields want to use the neuroscience finding to support their existing work—and in other cases, "data" and technology" work effectively—mostly in cases when fields want to extend their work by making neuroscience research into technical practice and pragmatic recommendations. A central question, then, for

the next chapter is one about an argument's role in translational processes; the chapter shows just how these different actors in different types of arguments establish a problem to be solved, are assembled to speak as the solution to the identified problem, are given a network of support, and then are able to lead the discourse so that other actors are unable to re-organize the problem and solution; but importantly, the argument and the conventions of the discipline combine to form different networks and make multiple ontologies of mirror neurons.

Cross Correlations of the Verb Forms and the Arguments Made

The six articles with a changing direction—those on the top half of Table 4.6—represent 18% of total coded qualified clauses and 13% of the total qualified clauses with citations attached. This number is low partially because no Group Analysis article has a changing direction of claim, and Group Analysis articles qualify more often than others. Further, the number is low because these articles use the brain code categories less often and cite less often. They likely do this because they are largely presenting certain arguments. Five of the six articles making radical suggestions for change are coded as having certain concluding claims, and the remaining 1 is only putting forward a mildly qualified claim. This makes qualified statements less likely and citations less likely. In short, when approaching a conversation about the brain or mirror neurons as if the facts have already been proved, it needs less proving, at least in cases when the end-goal is to change what a field is doing. Fields that support existing theories or practices can appear, on the whole, more cautious, can use careful qualified language throughout the article, can deploy citations from the

neurosciences to make the case for them, and can end the article with a strong concluding claim that, rhetorically speaking, places the weight of the claim on the neuroscience sources.

Cross Correlations of Citations Used and Arguments Made

What appears to need citation evidence are arguments that support existing theories and practices and do not seek to change in any respect what a field is doing. The seven articles in this category—three from Group Analysis, two from Movement Therapy, and one from Phenomenology—conclude with strong, certain claims; yet, at the same time, they comprise 46% (N=159) of the cited brain-as-actor certain present clauses. Thus, even when certain claims are made in these supporting arguments having a supporting direction, citations from the brain sciences appear to be about two to three times more likely than in other articles. Arguments supporting existing theories and practices with new neuroscience evidence tend to present strong, certain concluding claims and do so with a lot of citation support, even if they have a fair amount of qualified claims in the body of the text.

Looking specifically at the six articles that argue for some kind of alteration or change in theory or practice, there is a difference in the overall percentage of citations as compared to articles supporting existing theory or practice. Those six articles arguing for change—in the top half of Table 4.6—represent 20% (N=106) of total citations in all articles, and the remaining 15 articles represent 80% (N= 417) of citations. Although fewer articles argue for changes in theory or practice, those articles clearly cite brain sciences sources less often. They average 17.6 citations per article whereas the articles not arguing for any kind of change average 27.8 per article.

Five articles, or those appearing on the right side of the argument analysis in Table 4.6, can be considered qualified arguments, at least as measured by looking at their concluding claims. Those five articles represent 32% of total citations while the articles on the far left side of the chart—those only making certain argument claims in the conclusion sections—represent 68% of total citations. Overall, then, 1) articles arguing for big changes as a result of mirror neurons use fewer brain sciences citations, and 2) articles arguing without much concluding certainty use fewer brain sciences citations.[22]

This is exactly the opposite of what might be expected. It seems reasonable to believe that articles arguing for more radical changes would bolster those articles with many more citations. But this is not the case here, and this is likely because the number of citations is not the only factor involved. In coming chapters, what proves to be a better indicator of when articles need to enroll additional networks of support through citations as actor-networks is when those citations are helping along the translation of mirror neurons into the new field, and this depends on the fields' argumentative goals and disciplinary expectations for how to write and for who can or should be enrolled. In other words, this expectation is independent of the concerns of the fields and does not take into account why they might approach and animate mirror neuron sources in the first place. Seeing what each field is certain about and uncertain about and seeing how they aim to use mirror neurons explains this seemingly abnormal empirical finding. It can, indeed, make sense to cite more often with a claim that

[22] It is important to remember that some articles, as in Group Analysis, express variable certainty in the body of the text but have strong concluding claims; thus, they would be categorized here as "certain." In other words, this statement refers to fewer brain sciences sources appearing within articles not concluding with certain claims.

makes a relatively tame statement in a field if that claim, being made through the neurosciences, is a new way to make a claim in that field; direct and constant contact with the neurosciences may be required. Similarly, it can make sense to cite less often with a radical claim if the actors that are enrolled along with the neuroscience citations are also doing the work to make the case.

Conclusion

The data analysis outlined in this chapter shows a number of recurring features. Those include correlations between human actors and fields of study, as well as between human actors and the recurrence of qualified statements about brains or mirror neurons. The chapter also shows how mirror neurons appear in disciplinary texts fairly unquestioned as entities, how mirror neuron studies from the cognitive neurosciences appear in low numbers and are less frequent over time, and how these disciplinary arguments rely on a limited number of sources or on secondary sources with those articles seeking change for their fields most pronounced in this respect. However, this chapter's ending exploration of cross-correlations across code categories also suggests that these data are complex and likely have an intimate relationship to field-specific practices and discursive expectations.

The following chapter explores how the historical concerns of each field and the practices of each field combine in a complex interplay to enact "moments of translation" in the pursuit of persuasive arguments for increasing stability or change, which ultimately produce specific, sometimes idiosyncratic, conceptualizations of mirror neurons. The ensuing discussion sheds additional light on the data analysis outlined in this chapter and shows how

the recurring discursive features revealed in this quantitative descriptive approach indicate specific translational processes, or “moments of translation,” that can be further analyzed through a close rhetorical analysis of characteristic examples.

Specifically, Chapter 5 explores the actors made integral to the establishment of some problem in each field and shows how they arrange the solving of that problem. It then analyzes the differences and similarities across the networks of support constructed to solidify those actors into positions of authority. Finally, it investigates the logic of mirror neurons in each field, exploring their pragmatic contributions and ontological dimensions. Ultimately, what becomes apparent are the multiple ontologies of mirror neurons forged through varying discursive practices.

CHAPTER 5:

TRANSLATIONS OF MIRROR NEURONS IN FOUR FIELDS

This chapter aims to demonstrate the arguments of past chapters by using the data analysis as a scaffold of support for exploring how mirror neurons concretize and become connected to the world such that they become "real" in their situated contexts. Analyzing moments of translation within fields that turn to mirror neuron research in their own ways for their own reasons shows how field-specific actors serve as mediational means for the neuroscience research and arrange the discussion so the logic of mirror neurons constructs differently across fields. Additionally, the chapter shows how the mirror, as a metaphor with a sometimes long and complex historical record in a field, plays a key role in organizing actors as a scaffold of support for the empirical neurobiological finding to be understood as a mirror *in terms of* the field's conception of the importance of mirrors in their history of thought as well as a mirror *of* the field's existing problems. Accordingly, this chapter is organized by a discussion of each field in turn and its four moments of translation; characteristic examples from the text sample illuminate the discussion. The end of the chapter reviews the five analytic objectives, addressing how the rhetorical-translation analysis in this chapter achieves those objectives.

Group Analysis

Michel Callon (1986) describes “a new study of power” through an analysis of four moments in the sociology of translation, focusing on what happens when networks are undergoing change (p. 196). These moments include 1) problematisation, when actors become indispensible to other actors in the network by defining the nature of the problem; 2) interessement, when actors lock other actors into their defined roles through any available means to solve the problem; 3) enrolment, when actors interrelate the roles they allocated to solidify a scaffold of support; 4) mobilization, when actors protect and ensure the new network arrangement so as not to be betrayed, often by moving it out into the world where it becomes the new Standard or a new model of practice (p. 196). An interspersed discussion of the quantitative description data focuses and informs an exploration of these four moments.

But to the point of the chapter: examining the four moments of translation exposes how there is a particular reality to mirror neurons in each field. For Group Analysis, a small set of field-specific researchers establish the problem of the neurosciences for Group Analysis, become an obligatory passage point for understanding the meaning and significance of mirror neurons, and as a result, mirror neurons translate into a literal mirroring process familiar to the field and reflect the unique psychotherapeutic history of the field. The reality ultimately constructed by Group Analysis is one where mirror neurons validate the theories and practices of well-respected researchers now, in retrospect, defining Group Analysis.

This translation happens as a process wherein the problem of mirror neurons is positioned as not a problem at all; rather, mirror neurons expose a problem of wanting and needing quantitative evidence from the brain sciences to support its existing theories and practices. The neuroscience finding is, thus, made compatible with the field through a small set of field-specific psychoanalytic theorists of the mirror, and their explicit and often rigid interpretation of what mirror neurons *are* is then supported in a moment of enrolment by claims about the way "the brain" functions, framing psychoanalytic descriptions as unadulterated neuroscientific facts. The moment of mobilization happens amid an ensuing discussion of the current state of therapeutic practice and what mirror neurons are now said to mean for therapists and for the field.

Problematisation

In the case of Group Analysis, what immediately stands out from the textual analysis of actors is the high numbers of specific researchers (N=204 / 20%) and the low numbers of research studies (N=90 / 08%) and non-specific researchers (N=27 / 03%) that were mentioned across all articles sampled from the field. Additionally, the field uses "the brain" or "mirror neurons" as actors in the subject position more often than any other field, showing 17% (N= 184) against the other fields at 13% (N=172), 9% (N=128) and 8% (N=117) respectively. Thus, the data indicate the importance of specific human actors and mirror neurons as actors.

A closer look at these texts suggest that the articles in the sample orient the discussion of mirror neurons around a few specific Group Analysis researchers who use the mirror

metaphor as the foundational element of their theory and practice. In fact, the articles repeatedly foreground these researchers and establish the mirror as the key defining element in Group Analysis in the last half of the Twentieth Century. The positioning of these human actors as guides to understanding the field of Group Analysis persuades readers to subscribe to a particular conception of the field as one intrinsically and inseparably built from the mirror metaphor and, thereby, compatible with the mirror neurons of the neurosciences. This enables the neuroscience finding to be a confirmation of Group Analysis, or put conversely, this enables Group Analysis researchers to interpret the neuroscience finding in a favorable way. In Callon's terms, the foregrounding of these human actors in Group Analysis is the moment of problematisation, when certain actors are positioned so as to define the problem and become indispensible to a new network of Group Analysis that is now under formation (p. 196).

For example, Victor Schermer (2010) in his Group Analysis article, "Reflections on 'Reflections on Mirroring'" discusses the importance of mirror neurons for Group Analysis, saying that the finding "affords an obvious parallel" to Malcom Pines' interpersonal mirroring of behaviors in group therapy sessions, which are designed to develop emotional "attunement" between group members. That an empirical, neurobiological finding affords an "obvious parallel" (p. 221) to psychoanalytic therapy is an early indicator that the human researchers discussed as representatives of Group Analysis provide a framework of interpretation for mirror neurons. Indeed, Schermer writes, "The prescience of Malcolm's views on mirroring is thus highlighted by the fact that only a few years afterwards, neurons were discovered that perform some of the very functions he described. In effect, mirror

neurons are the ‘mirrors-in-the-brain’” (p. 222). Here, Schermer situates mirror neurons as an equivalent to the theorized behavioral “mirroring” explored by Pines in his 1984 article “Reflections on Mirroring.” Schermer later states, “Malcolm’s Reflections on Mirroring takes us on a journey ‘through the looking glass.’ It awakens us to the intersubjective state in which we recognize ourselves in each other in a direct and vivid way, as if looking into a mirror. Malcolm shows us how we are not only alienated in a Lacanian mirror stage, we also grow, develop, and achieve mature personhood through the mirror’s reflections.” (p. 224) In this last comment, the phrase “the mirror’s reflections” refers both to the way Pines suggests that human psychological development is largely dependent on how individuals perceive themselves being “reflected back” by others while also referring intertextually to mirror neurons as the explanation for why Pines was right about his theory in the first place. Thus, setting up the passage with a reference to fairytales where characters peer “through the looking glass” suggests the idea that seeing a facial reflection is also a seeing through-ness to the Self where personality—whether the charity or vanity animated in Snow White or in Alice and Wonderland—are reflected back at the viewer because of mirror neurons.

In another Group Analysis article from the text sample, Nancy Wolf et al. (2001) “try to show how the mirror neuron system might be involved in a developmental sequence hypothesized by Kohut (1984), Stern (1985), and others to begin in infancy” (p. 95). Wolf et al. argue that mirror neurons act as a “primitive dialogue” in the brain between Self and Other wherein gestures trigger affective resonance, which allows for the eventual development of mutual understanding and empathy. The mediation of work by Kohut and

Stern as a way to situate mirror neurons and their importance is most evident in a passage where Wolf et al. state,

> Let's begin with Stern. He describes a process he calls affect attunement (p. 142), that is, the 'performance of behaviors that express the quality of feeling a shared affect state, without imitating the exact behavioral expression of the inner state' (p. 161). He explains that 'attunement is a recasting or restatement of a subjective state' (p. 161)… 'affect attunement' may be a term that names, as a separate process, an ongoing developmental [mirror neuron] process already in place. (p. 102)

Mirror neurons are positioned here as potentially explanatory to Stern's observations, just with different languaging and at a lower level of processing. Wolf et al., in short, explain mirror neurons by turning to Stern's discussion of the infant, making "affect attunement" the ultimate end product of mirror neuron functioning that stands at the core of understanding others. They state,

> Along with this increasing sensory-perceptual organization, the infant also gains enhanced motor control, accompanied by a period of intense social interest (from age 2 to 6 months (Stern's formation of the core self; Stern et al. 1998, p. 72)). Perhaps this enhanced sociability, marked by an increased interest in the already highly valued human face and the increasingly developed motor control, coincides with increased neural development and specificity toward subtleties of facial gesture. In other words, perhaps the mirror neurons in the premotor cortex take on a strong developmental role at this time. (p. 99)

In other words, mirror neurons are positioned to explain Stern's observations and give increased prominence to his imitative approach within the field of Group Analysis. In this way, specific Group Analysis researchers, like Stern, become what Latour (1987) calls "obligatory passage points" (p. 182). For Latour, weather stations are "obligatory for everyone who wants to know the weather. If they [weather stations] are successful, they will become the only official mouthpiece of the earth's weather" (p. 182). Likewise, Group Analysis researchers are, in these articles, the official mouthpieces of mirror neurons. Mirror neurons are, thus, known through them.

Indeed, all articles in the text sample from Group Analysis end up arguing that mirror neurons ultimately validate psychoanalytic theorists of the mirror by showing how the new science of the brain bolsters their theories; that is, their theories, because of mirror neurons, can now be seen as powerfully explanatory to human behavior.[23] Schermer makes this explicit when he states, "The shortcoming of the mirror metaphor for analytic understanding is that it is so experience-near to the quasi-magical qualities of attachment, empathy and attunement that, as a metaphor that emphasizes a 'glance' or a 'look', it does not sufficiently allude to the countless learned repetitions and variations that are required to build the sinewy 'muscle' of interpersonal relations" (p. 220). For Schermer, in other words, mirror neurons pick up the slack of the mirror metaphor in Group Analysis insofar as the neurosciences can now go further and explain why the practices of "mirroring" others works. The neuroscience

[23] In one article, the concluding claim was coded in the argument analysis as "extending" the field of Group Analysis; however, this code is different from "revising" the field and assumes field validation. Existing practices were, in other words, validated and then extended.

extends the notion of “attunement” that Pines developed from reading Foulkes (1964; 1971) and Stern’s (1985) “empathetic attunement” between Mother and child such that the neuroscience lengthens the previous emphasis in Group Analysis on the developmental power of internalizing “a look” out to the whole of human behavior. Mirror neurons, in this way, when compared to the mirror of Lacan’s “mirror stage” and then subsequently extended through Foulkes, Stern, and Pines, becomes an ocular-central core of all possibilities for human psychological development. Again, here, the researchers serve as the obligatory passage point for interpreting mirror neurons, and consequently, those researchers benefit. The finding is said to confirm, in magnanimous scope, the validity of the mirroring theories and practices of Group Analysis.

In Callon’s terms, this arrangement of actors is a moment of problematisation that allows specific actors to speak for Group Analysis as a field and to define the problem that the field confronts with new neuroscientific research into mirror neurons. Indeed, the potential problem faced with the popularity of new neuroscience research set as an ultimate explanatory mechanism for human behavior is not one of reconsideration for Group Analysis where researchers must rewrite their field-specific theorists; rather, by centralizing past theorists of the mirror and making them obligatory passage points, the problem becomes one of confirmation and extension. And it is this confirmation and extension that *is* the contribution of mirror neurons to the field of Group Analysis. In ANT terms, the actor-network of Group Analysis is re-arranged to frame the problem the neurosciences might otherwise pose as about the need to show alignments between mirror neurons and Group Analysis, as one about taking advantage of their prominent form of evidence.

Interessment

Two other articles from the text sample further demonstrate the moment of problematisation, showing how the problem is set up as demonstrating alignments between Group Analysis and the neurosciences and then, in an almost simultaneous moment of interessement, actors are arranged to solve the problem, making mirror neurons into acceptable knowledge for the field. Through assigning actors roles and inter-relating them, in other words, Group Analysis is made to be "interested" in mirror neurons, their meanings and associations are upheld as mutual and entwined. In one article, by Rocco Antonio Pisani (2010), mirror neurons confirm that Pines' use of mirroring facial expressions and gestures in the practices of Group Analysis were, in fact, significant contributions now retrospectively confirmed by the neurosciences. Pisani states,

> Mirror neurons complete and give a neurobiological foundation to the mirror phenomenon in Group Analysis. They are essential for the sharing of human experiences... It should also be noted that the resonance phenomenon finds its neurobiological bases in the neural mirror system: [quoting Pines now he states] 'Resonance behaviours can be seen as supporting the development of gestural communication, language and other aspects of social relating.' (p. 332)

Interestingly, in this passage, mirror neurons give a new "foundation" to mirroring in Group Analysis even though the theory was already accepted and practiced and even though the central claim is set-up, both before and after, by quotations from Pines, not from cognitive neuroscientists researching mirror neurons. This demonstrates how mirror neurons are assigned the role of being new evidence that confirms the "truth" of Group Analysis but also

how the mirroring practices of the researchers in Group Analysis who developed those therapies speak for the field when the field interprets the meaning of the biology of mirror neurons. In other words, the field-specific researchers who are constructing the reality of the field operate as actors through which the interests of neuroscience, mirror neurons, and Group Analysis are locked into place. The field's notable figureheads, who are already associated with the idea of a mirror, are already "real" to the field and are able to fold mirror neurons into the reality of their network. The low number of appeals to research studies (N=90 / 8%) and to general "researchers" (N=27 / 3%) against the high number of appeals to specific researchers (N=204 / 20%) across all of the Group Analysis texts indicate that this kind of re-assembly through specific individuals, this mode of interessement, is widespread.

In a similar translational process, in a second article, entitled "Empathy and Group Analysis: An Integrative Approach," Ana Sophia Nava (2007) tries to correlate the science of mirror neurons with Kohut's (1984) view of empathy, making him a mouthpiece for mirror neurons. Nava does this by first describing Kohut's view of empathy as "the ability to penetrate, by means of thought and feeling, into the other person's inner life" (p. 15) and then explains how neuroscientific work by Jean Decety (1997) argues that "empathy" follows a model of perception-action in-line with Kohut's view of empathy. Nava argues that Decety's work confirms Kohut's insofar as it shows that empathy originates as an affective innate sharing between Self and Other that becomes conscious and causes a subjective adoption of the Other's mental states. Nava puts it this way: "Through the model of perception-action, we know that there are shared representations between the patient's emotions and the analyst's

respective neuronal circuits. In other words, the patient's emotion is mirrored, through the mirror neuron, in the neuronal circuits that codify the same emotion in the analyst" (p. 20).

Here, the initial psychotherapeutic description following from Heinz Kohut's work is restated through the language of "neuronal circuits" and completely replaced in the second sentence by the mirror neuron explanation. What proves fascinating, though, is the way that Nava declares what "we know" from neuroscience to be what is known by Kohut, which is now evidenced, and further known, by mirror neurons.

Yet, Nava has little cause from which to jump from mirror neuron studies to the claim that people have "shared representations," which would equate to mirror neurons constituting a direct embodied correlation between two people, a thesis that has been hotly contested (Cisbra, 2005; Jacob, 2008; Umiltà et al., 2001). The long and short of this translational outcome is that Foulkes, Stern, Pines, and Kohut become indispensible to the new network of Group Analysis when it must re-assemble in response to neuroscience work on mirror neurons, resulting in a specific kind of interpretation of mirror neuron functioning and purpose.

The working out of mirror neuron research through references to past Group Analysis researchers defines a role for mirror neurons, i.e. the translation defines the motivations and interests of mirror neurons, "interesses" them to the aims of Group Analysis research, and then sets them in that research history by using them as facts of the field. Mirror neurons become confirmations or explanations of therapeutic "mirroring" practices known only previously through psychoanalytic theorizations. Mirror neurons are known *in terms of* the mirror known best to the field.

The data analysis implies that this translational process—where mirror neurons are locked into practices previously known—is more widespread by revealing a low reliance on neuroscience sources in the discourse. In fact, the data analysis shows that the field of Group Analysis is dependent on secondary neuroscience sources (67%) when neurosciences sources are used, relying more often on that type of source than any other field in the sample. Overall, the data analysis indicates that fields using neuroscientific work to build support for their own existing theories and practices deploy less sources overall and rely more often on secondary sources; this makes some sense when considering that mirror neurons are not interrogated as a biological entity in these cases. Their interpretation is delivered through the Group Analysis researchers, not through the original neuroscience studies. The neuroscience, rather, acts as a broad scaffold of support for the pre-packaged field-specific interpretation. Consequently, separating the mirror from the mirror neuron eventually becomes close to impossible. Indeed, the mirror neuron, as biological artifact, becomes the mirror, or at least, becomes definitionally confused with the properties of a mirror in the mirror metaphor that was so common in theorizing the usefulness of imitating behaviors.

For example, looking closely at the last quote by Nava shows how the logic of the mirror neuron follows the logic of the everyday mirror one might have back home. Nava states, “the patient’s emotion is mirrored, through the mirror neuron, in the neuronal circuits that codify the same emotion in the analyst” (p. 20). The mirror neuron is imagined as reflecting back an exact or direct reflection like a mirror. At this moment of interessement, the mirror neuron is locked into its role, being united with the idea of mirroring the actions of

patients like a reflecting mirror, becoming evidence for an idea central to the Group Analysis researchers, like Kohut and Pines, who are organizing the new network being formed.

However, it should be noted that the association of mirror neurons with the mirror theories and mirroring behavioral practices of Group Analysis, or with an actual mirror, is non-necessary. Defined through other means or inter-related with other sources, mirror neurons are easily dislocated from an association with these conceptions. It is only the interessement of researchers like Kohut and Pines that stabilizes the new network. In short, defining these actors' positions allows the reality of mirror neurons, as Group Analysis mirrors, to take hold.

This is not to suggest that Nava does not put forward evidence for this logic of direct correlation between mirrored mirror neurons in two different brains. To the contrary, Nava is one of the few Group Analysis researchers to cite several mirror neuron studies. She cites Fadiga et al, 1995, Decety et al., 1997, 2002, Ruby and Decety, 2001, Iacoboni et al., 1999, and Clark, 2003 and then states, "On the whole, the representations shared between the self and the other at a cortical level were found at the level of comprehension, pain processing and recognition of the emotions" (p. 18). What Nava fails to mention, however, are the limitations of those studies, which draw conclusions from past studies on monkeys, show only some mirror neuron responses in relation to specific kinds of actions, and uphold no direct correlation of responses in mirror neurons across human brains but rather indicate, at best, cortical areas engaged in similar neuronal firings that must be interpreted as "mirroring" not as doing something else, like "simulating" or "predicting," as several cognitive philosophers and neuroscientists have since argued (Cisbra, 2005; Jacob, 2008; Turella,

2009). The direct embodied correlation hypothesis of the mirror neuron, in short, is not supported by these research studies. It seems logical that the Group Analysis researchers mediating the discussion heavily influence the interpretation of the function of mirror neurons.

Enrolment

The influence of Group Analysis researchers raises how enrolment works in the translational process. As Group Analysis incorporates mirror neurons by turning to field-specific researchers, the idea of brains and what they do is enrolled as support alongside of a limited set of citations about mirror neurons. An emphasis on "brains" and "mirror neurons," in other words, works rhetorically in these texts to validate the field's conceptions through the framework of the neurosciences without actually citing many mirror neuron studies.

Indeed, the articles sampled from Group Analysis use half the number of neuroscience sources as Robotics and Movement Therapy—49 in total compared against a sample average of 64 and a field sample high of 81—while also using the words "mirror neurons" and "brains" in the subject position in the discourse more than any other field. The enrollment of "brains" is witnessed in the recurrence of passages that repeatedly invoke "the brain" as an actor with few or no relevant citations. Saying what the brain *is* and *does* acts to support the network and guard against other interpretations of mirror neurons that might stand against the field-specific theorists' conceptions of the brain.

Although the textual analysis showed that qualified statements inform Group Analysis articles, the location of those qualifications helps to reveal the moment of

enrolment; those qualifications appear specifically around the Group Analysis interpretation of what mirror neurons mean for the field, not around what brains or mirror neurons *are*, revealing how appeals to people's "brains" in general work alongside of a lack of citations to support the suggested interpretation of mirror neurons as mirrors like those mirrors theorized in Group Analysis. In other words, discursively situating "the brain" into a support role for the interpretation advanced by field-specific researchers makes sure that the mirror practices of Group Analysis become inseparable from what is presented as the certain, unambiguous "brain" and functioning of mirror neurons. This occurs despite the fact that the interpretation of mirror neurons is, as Ann Marie Mol (2002) says of all scientific interpretations, immanently "localized" and a single reality (p. 55). Yet, the moment of enrolment solidifies the network as it has been (re)arranged such that "the brain"—and the assumed network of the Cognitive Neurosciences associated with claims about the brain—can now be said to confirm Group Analysis and ensure a successful translation of the neuro into the field.

Looking at the text reveals how "the brain" becomes an intermediary for talking about mirror neurons in a way that the theories of field-specific researchers can be said to have associations with them. Put differently, "the brain" becomes an additional actor that reinforces or secures the role of mouthpiece for field-specific researchers. This can be seen through the recurrence of two phenomena in the sampled articles: 1) passages that repeatedly invoke the same neuroscience researcher and the brain as an actor with few or no citations, and 2) passages where the brain is stated as conclusively X but the claims about the interpretation given through Group Analysis researchers are qualified. This movement from certainty to qualification allows "the brain" to be the evidence, not the Group Analysis

researchers themselves, for establishing the alignments between mirror neurons and Group Analysis. Although Group Analysis researchers are "interessed" in mirror neurons, the evidence for the appropriateness of that interessement is "the brain," lest Group Analysis researchers appear self-confirming.

For example, in an article written by Pines (2003) himself, "the brain" and one neuroscience researcher, Walter Freeman, are situated as the actors in a back and forth movement with no citations:

> According to Freeman, each brain has a private language, but each is also a unit in society. He asserts that the very basic structure of the brain, the neuropil, has what he calls an intentional structure, by which he means 'the process of a brain in action, having the properties of unity, wholeness and intent, which is the tension of taking in by stretching forth.' Brains shape themselves to accord with the input they get by acting into the world… From his researches, Freeman asserts that brains are creative, that the basic brain structure, the neuropil actively stretches forth in search of input.
>
> Brains are designed by the environment as agents for social construction. (p. 509)

Amid this entire discussion, there is no citation; one citation from Freeman did appear, but it was placed prior to the passage quoted here—not within it or after it. Instead, what Freeman says about brains and their condition of always shaping themselves and incorporating the environment establishes support for an interpretation of mirror neurons as always functioning like a mirror, seemingly proving that brains are, essentially, mirrors.

This lack of reliance on citations happens in other articles as well. Pisani, for instance, enters into a long discussion of "the brain" with no citations to neuroscience sources, quoting, instead, Malcom Pines. Pisani states,

> In [Pines'] 'Neurobiology and Group Analysis': 'The brain is a social organ; neural networks are formed by the interaction of organism and environment; the brain is a social organ dedicated to receiving, processing and communicating messages across the 'social synapse'; the right brain develops first, organizes and stores many social and emotional experiences: shared unconscious dialogues. Left brain is biased to positive emotions, the right to negative… *Mirror neurons live at crossroad of processing of inner and outer experience*.' (p. 332, italics in original)

In this passage, "the brain" is and does many undisputed things, and "the brain" does the rhetorical work of legitimization, not the citations.

However, in later passages, qualifications do appear, but they appear specifically around the Group Analysis interpretations of the neuroscience when the articles are comparing the apparently objective findings about "the brain" to the work of Group Analysis researchers. For instance, a few paragraphs after the passage cited above, Pines moves back and forth between the objective and certain clauses associated with the neurosciences and the qualified clauses associated with his interpretation of the neuroscience studies. This can be seen in the words emphasized in bold when he states,

> They [mirror neurons] **are unique** because they are activated both during the execution of actual movement and when the animal looks at the same action performed by another individual…. So, **it is possible** that the mirror neuron system

> represents an ancient recognition system… It [the mirror neuron system] **is a** basic primitive, communicative pathway through which the animal performs and perhaps learns from the action of another... **This can be seen as** the establishment of primitive dialogue. (p. 509-510, bold not in original)

Similarly, in Wolf et al., the article begins with the opening statement that "First we summarize **the research findings** about mirror neurons and how they apply to humans. We then **attempt to demonstrate** how the mirror neuron system **might be involved** in a developmental sequence hypothesized by Kohut (1984), Stern (1985), and others to begin in infancy" (p. 94-95, bold not in original).

Thus, as Johnson and Littlefield have noted, these cross-disciplinary explorations involving the neurosciences tend to treat neuroscience studies "as big-S Science itself," as an objective and unproblematic entity. But what a close reading of the Group Analysis articles demonstrates is that the interpretation of the Science is certain when coming from the neurosciences but is qualified when it is an interpretation of what it can do for Group Analysis. Instability and possibility is, thus, recognized in the grammar as this secondary process of re-interpreting the neurosciences for one's own field opens up the finding to some uncertainty and variability. Nevertheless, the recognition that the Group Analysis interpretation "might be" incorrect is not balanced with or against a plethora of sources or juxtaposed with sources providing alternative explanations. The mediation of the neuroscience through the singular lens of Group Analysis work on behavioral mirroring still reigns supreme, is enabled through these subtle interjected qualifications, all while appeals to "the brain" do much of the evidential work without citations from the brain sciences. In

addition, the concluding statements of all but one Group Analysis article were strong and certain, indicating just how qualifying the means of interpretation in the body of the text can work to enable later concluding certainties that are poised to fall back on those qualifications if challenged.

Indeed, evidence of "positive modalization" (Latour, 1987, p.) is found in the assertion that Group Analysis articles appeal more often to "brains" and "mirrors in the brain" than to specific research studies; these compressed or "punctualized actors" serve as intermediaries for Group Analysis researchers and their interpretations of mirror neurons in ways that sources do not. This is seen not only in how few neuroscience sources are used across the sampled articles but how little agreement there is amongst which sources to use. Of the 7 articles that appear 4 times or more across the set of Group Analysis articles, only 3 of those 7 articles deal with mirror neuron studies specifically, and 2 of those are "founding articles" dating from 1995 and 1998; the other 2 date from 2004 and 2009. In addition, 34 of the 49 brain science sources used across all articles in Group Analysis pre-date 2001, showing how the scaffold of support is not only thin but old. Thus, enrolling support for translating mirror neurons into Group Analysis is not so much about the citations themselves as it is about the brain and mirror neurons as actors and the human Group Analysis researchers as mediating actors. Put differently, the neuroscience is taken for granted, and these black-boxed "brain" actors lend legitimacy to an interpretation of mirror neurons that comes from Group Analysis researchers, balancing the insecurity in the body of the text expressed through words like "might."

It is valuable here to note that appeals to “the brain” as a closed, unproblematic black-box have already been shown to be persuasive. Weisberg et al. (2008), for one, document the “seductive allure” of the brain, revealing that completely irrelevant neuroscience information inserted into passages about a psychological phenomenon disrupt logical evaluation and “may encourage people to believe they have received a scientific explanation when they have not” (470). From their study, Weisberg et al. conclude that “Because articles in both the popular press and scientific journals often focus on how neuroscientific findings can help to explain human behavior, people’s fascination with cognitive neuroscience can be re-described as people’s fascination with *explanations* involving a neuropsychological component” (470, italics in original). Building from this basic thesis that people’s fascination with explanations disrupt their evaluation of claims about how exactly a neuro study evidences an argument suggests that claims like “Brains shape themselves” (Pines p. 509) and “Mirror neurons live at crossroad of processing of inner and outer experience” (Pisani [quoting Pines] p. 332) do not need citations—they only need the appearance of explaining the situation at hand.

This is not to suggest that the authors in Group Analysis intentionally litter their articles with vague references to brains and brain functions to disrupt readers’ logical processes. This is merely to suggest that these articles remain persuasive even though they use few neuroscience citations because appeals to the brain are persuasive when positioned as explanations of psychological processes. Further, the discussion of Weisberg et al. suggests that the brain and mirror neurons must be black-boxed if they are going to tell the reader what the mirror neuron is and what the brain does in order to support Group Analysis’

existing conceptions. What is important, in other words, is what these phenomena are—"social organs"—and what they do—"shape," "connect" and "live." In this way, the brain actors act "as a piece of machinery or a set of commands that is too complex" (Latour, 1987, p.3), and so they are "black-boxed," which makes them actors and agents in the discussion. That machinery achieves the functional purposes of the argument. Having neuroscience mediated by popular human actors in Group Analysis can, in short, work both ways—to lend neuroscientific black-boxes increased legitimacy and, in turn, to lend the Group Analysis researchers increased legitimacy.

But this process of translation not only fails to recognize the controversies and multiplicities among the neuroscientific literature investigating mirror neurons, it can also distance other work in the field of Group Analysis that does not align with the interpretation of mirror neurons a researcher might want. For instance, in the tradition of Group Analysis, there are analysts focusing on forming and addressing the group as a whole and who do not focus on the individual—such as Lois Holzman and Fred Newman. Additionally, Irvin D. Yalom (2005) lists imitating behaviors as only one among a list of eleven common traditions in Group Analysis (p. 1-2). All in all, a moment of enrolment enacted through the power of brains and what they *are* narrows the possibilities for interpretation when mirror neurons are moved into Group Analysis.

Mobilisation

Four of the five articles in the Group Analysis sample end with a discussion section where the implications for therapeutic practice are discussed. What proves interesting about

this section is the way that it is written. Crafted in the interpersonal "we" voice, the text interpellates its audience as in agreement with the discussion and approaching it from the same perspective as the article. In this way, the text positions the discussion as a new orientation of the field, as what the neuroscience leads researchers to likely conclude. For example, Wolf et al. write,

> But as analysts, apart from serving as case coordinators for such a complex treatment, our understanding of mirror neuron functioning might lead us to conclude that intervening at the level of gesture, both facially and manually, would be of primary importance. This would support a therapeutic focus that concentrates on gestures as having meaning. By persistent practice of such social interchange, there could be an enhancement of the mirror neuron system. We will attempt to illustrate the likely operation of the mirror neuron system in an autistic patient. (p. 107)

In this example, what "our" collective understanding "might lead us to conclude" is the importance of a new form of practice whose efficacy is demonstrated through a subsequent performance of therapeutic work with an autistic child. Here, the personal experience of a therapist performing new Group Analysis practices with a real-life patient evidences a conception of mirror neurons developed from what "Kohut speculated" (p. 108) and, in turn, suggests that interpersonal practice confirms "our" suspicions and what "we" should probably start doing.

Similarly, Pines uses the interpersonal voice to position his interpretation of mirror neurons as shared and to move it out into the world of practice. He states,

> You will recall that Foulkes described resonance as the individual responses that

> group members make to shared events, each responding at their own level of attunement to the predominant affect in the group. We [analysts, broadly speaking] study the individual responses that are made to a shared event…On the psychodynamic level, we can observe responses of mirroring and resonance and of non-mirroring and non-resonance in participants in small groups. (p. 512)

In other words, Pines argues in this 2003 article that what the analyst sees in the group dynamic is the functioning of mirror neurons, and he further argues that the role of the analyst should, as a result, be to view the patients as good working mirrors or as dim reflectors. He states, "In the analytic group, non-resonance can progress to resonance, non-mirroring to mirroring" (p. 512). For him, this is the goal of the analyst. One supposes that there is nothing wrong with equating perceptions of a patient's emotional resonance to "mirroring behaviors" and then equating those behaviors to mirror neurons except that Pines engages in what Davi Johnson calls a "biosocial" articulation; this means biological terms are deployed to stand-in for social behaviors such that saying someone is "cingulate" communicates a disorder (Johnson, 2008, p. 149-150). Put simply, Pines engages in an effort to make the practice of being a group analyst something that is directly corresponded to and informed by the neurosciences. Thus, the conception of Group Analysis he advances performs a moment of mobilization as it becomes a practice, becomes a model, a way of instructing the analyst to see the patient. Here, the translational process spins around full circle: the neuroscience is first interpreted in terms of prominent mirror theorists known to the field, it then confirms their theories and practices, and it is, at the end of the cycle, used as evidence for a stronger focus on mirroring behaviors and for organizing the work of the

analyst around measuring the mirror-ness of people conceptualized as mirrors. This process re-affirms and, potentially, balloons the importance of thinking about the mirror in the practice of diagnosing a patient's condition, moving the translation of mirror neurons into the larger world as a new Standard Model, concretizing the new actor-network of Group Analysis assembled in these articles.

When these discussion sections that reflect on and develop the practices of analysts are placed contextually—that is, after the article sets up the importance of the neurosciences as new evidence for a phenomena that has been traditionally studied and accepted through the subjective accounts of analysts in the group setting—they effectively communicate that the value of the analyst's perspective is not subsumed by the neurosciences. The language of "us" and "we" suggests that the analyst still interprets the group setting; valid forms of knowing close to the field remain valued.

Nava makes this explicit, ending her article by saying, "We cannot expect our analyst, our supervisor and the literature to do all the work to discover our faults. There is a very important amount of personal work to be done... our own clinical investigation provides us with the data with which we can deduce new theoretical conceptualizations" (p. 26). So although the neurosciences help Group Analysis to understand psychological phenomena better and provide new and important evidence, the coming together of the two fields does not replace the necessity for interpersonal reflection and subjective knowing. In ANT terms, this further secures the new network by protecting the values of the analyst, eliminating that possible contention, and simultaneously moving the discussion of mirror neurons out into the field as it is traditionally practiced. This recognition of the analyst elevates the role of the

analyst even as it attempts to solidify a new model built through the significance and meaning of mirror neurons.

Ultimately, by examining the dominant actors indicated by the data analysis and by following those actors as they arrange roles and then secure those roles, what becomes evident is how Group Analysis defines mirror neurons in terms of itself and reflects itself back at itself, like a mirror.

Movement Therapy

Movement Therapy and Group Analysis are similar, like-minded fields. They both follow out of a tradition of psychoanalysis; however, they have their own field specialty journals, key researchers, and concerns. Specifically, the articles from Movement Therapy express quite a bit of concern about the field's own way of knowing through the subjective reports of therapists interacting with patients and, like Group Analysis, turn to the neurosciences for additional evidence that "proves" that the field is, in fact, valid and legitimate. Thus, many of the translational processes follow the same pattern, but what is different about Movement Therapy is the way that several articles from this sample blend together their own field-specific researchers and neuroscience researchers to suggest that the two fields, despite their radically different methods and writing practices, really are not very different in terms of their conclusions and can compliment each other. In fact, the Movement Therapy articles argue that the new neuroscience work that values mind-body-environment interactions, typified in mirror neurons, now shows that Movement Therapy was right all

along about its Anti-Cartesian stance; the field can “prove” their belief and relevancy to the world through the neurosciences. Further, Movement Therapy differs from Group Analysis insofar as it performs a hybrid style of writing that demonstrates the expectation of the field to speak through subjective interpersonal narratives as well as the new desire of the field to incorporate quantitative data from the neurosciences and “strengthen” its epistemology; thus, the articles appeal in some cases to extremely personal experiences written in narrative form as evidence for the primary claim and, in other cases in the same article, appeal to specific neuroscience studies and data.

These similarities and differences in the translational process are initially evident in the data analysis. Like the articles sampled from Group Analysis, those from Movement Therapy organize the discourse largely through human actors. They do so at a rate of about 47% (N=724) when the brain actor codes are included and 68% when not included. Movement Therapy, however, also uses more nonhuman actors, showing 27% (N=338) against Group Analysis at 22% (N=231). In fact, despite the high deployments of human actors, clauses centering research studies as actors are more common in Movement Therapy than in any other field (N=235 / 19%). In addition to this, Movement Therapy has the second highest number of brain-as-actor clauses, showing 13% (N=166) compared to Group Analysis’ high at 17% (N=181). The question, then, is how human actors alternate with appeals to “research” in ways unseen in other fields and where or how “the brain” also plays a role as an actor.

These questions posed by the data analysis productively intersect with unique features in the argument analysis. Indeed, what proves interesting about Movement Therapy is the

way sampled articles argue that mirror neurons explain phenomena previously unexplainable through the traditional methods of Movement Therapy and, then, ultimately support the body-brain connection motivating the field of Movement Therapy by highlighting the mirror neuron interpretation that the body directly simulates observed movements. In this way, the practices of Movement Therapy are validated. Three of those articles specifically argue that because mirror neurons support the field's imitative simulation-based movement therapies, movement therapists should change their tactics and build more bridges with quantitative researchers and with the data of the neurosciences in order to augment their traditional, narrative-based evidence and reporting style. This recommendation follows from expressed anxieties about the position or authority of the field as a whole, and those articles attempting to augment this perceived evidential deficiency incorporate quantitative data into their texts.

Addressing these anxieties and crafting an argumentative trajectory that, on the one hand, validates the premise and purpose of Movement Therapy while, on the other hand, re-makes its methodological alignments is how research studies, as actors, appear in the discourse in tandem with "brains" and "mirror neurons" and studies and data. Working to legitimize Movement Therapy through brain data and brain research serves the rhetorical argumentative function. One result is that Movement Therapy ends up using more citations than any other field—200 citations in total from 80 unique brain sciences sources; the newly proposed discursive form of Movement Therapy—one engaged with the sciences and quantitative information—is actively modeled in these articles as they cite brain studies and invoke "research" but still maintain that subjective patient-therapist accounts remain valid forms of knowledge.

Interestingly, what results from this mix of messages is that mirror neurons are, by and large, like Group Analysis, interpreted in a strict and singular way with little variation.[24] And once again, field-specific human actors prove key to the moment of problematisation as those actors become the primary spokespersons for the problems of the field and as they turn to neuroscience research and brains as a scaffold of support. In the process of defining, interrelating, and protecting the established roles, an interpretation of mirror neurons is formed, and it remains highly specific to what the spokesperson's arranged problem for the field requires. Simply put, interpreting mirror neurons in Movement Therapy function as a means to prove that the field can productively intersect with the "hard" sciences without abandoning its disciplinary traditions and foundations. Mirror neurons once again become a mirror in terms of the field and a mirror of the field.

Problematisation

Three articles from the sample argue that mirror neurons support Movement Therapy's practices but also provide new insight that should cause therapists to appeal to the neurosciences, adjust their methods, or change their orientation toward the quantitative sciences. Although all three articles arrange Movement Therapy researchers as inseparable from the interpretation of the meaning of mirror neurons—as was witnessed in Group Analysis—the means by which those field-specific researchers do this differs. In Movement Therapy, the views of the human actor are not laid out and then compared to the science of

[24] Only one article in the sample recognizes that mirror neurons might not enact a direct embodied simulation and do not respond to all human actions but only a select few that are "goal-oriented."

mirror neurons; rather, the human actors from Movement Therapy seem to already define the science of mirror neurons through citations. So the current research is, in a sense, writing mirror neurons back into the older literature. For example, in "Embodied Concepts of Neurobiology in Dance/Movement Practice," Kalila Homan (2010) begins her article saying, "Recent developments in affective and physiological neuroscience research are beginning to reveal observable interconnections between the body and the functioning of the mind (Damasio, 1999; Hart, 2008; Iacoboni, Molnar-Szakacs, Gallese, Buccino, & Mazziotta, 2005; Ledoux, 1998; Panksepp, 2007; Porges, 2005b, 2009a)" (p. 80).

Here, right from the beginning, Homan uses citations to incorporate field-specific researchers and their inherent weight as a familiar actor-network in the field of Movement Therapy, mixing them with different brain sciences citations. One citation in this list is from a primary mirror neuron study by Iacoboni et al., several are from secondary brain science sources like Damasio's "The Feeling of What Happens" and Hart's "Brain, Attachment, and Personality: An introduction to neuro-affect development," and the other citations are popular psychoanalytic-cognitive science cross-over books, such as the one by Ledoux titled "The Emotional Brain: The mysterious underpinnings of emotional life" and the one by Porges in a book titled, "The Healing Power of Emotion." In short, the article blends together sources in a way that makes separating out their disciplinary differences and directions and then thinking about the role and function of mirror neuron studies in reference to the claims about Movement Therapy extremely difficult to do. Mirror neuron studies are already constructed together in a new actor-network of sources, a network that comes into appearance in the article through the blending or smearing of disciplinary distinctions.

This is a moment of problematisation, when certain actors become indispensible to the network because they are setting up the problem that needs to be addressed. In this particular case, the problem that needs to be addressed, as in Group Analysis, is not one about the neurosciences disproving the value or validity of Movement Therapy. That possibility is ruled out right in the first sentence as the long chain of blended citations makes entirely evident. Rather, the problem situated here is, first of all, one about needing others to realize that Movement Therapy as a field should be highly valued because it does not follow a Cartesian tradition of separating the mind from the body and because it is in-tune with the new holistic image of the neurosciences as represented through the exciting mirror neuron research. As Holman states,

> As we learn more about how the mind functions, it is clear that consciousness cannot be severed from the body…Mirror neurons track nonverbal body communication and are part of the complex system that allows us to understand each other's intentions… Affective and physiological neuroscience seeks to explain how the physical body is linked to neurological processing. Dance/movement therapists have known this implicitly, but we are now gaining the language to describe and understand it. (p. 95-96)

Thus, what movement therapists already knew is now "proved" by the neurosciences, even though the therapists, on some "implicit" level already "knew" this. Thus, the field in the eyes of others is ripe for increased respect and authority.

As might already be evident, the second problem presented here is one of needing movement therapists to understand what is *really* happening when movement therapies

alleviate a patient's problematic mental states. This, of course, assumes that behavioral observation and subjective reporting of patient progress from therapists cannot really get-at what is *really* happening. That is a job for the neurosciences, which, in these articles, are positioned as having privileged access to a material reality that *is the* reality of explanation.

Bonnie Meekums (2010), for instance, in her article, "Moving toward evidence for Dance/Movement Therapy" states in her conclusion that therapists can use large data sets and start "linking these to process so that practitioners and others can learn more about what it is that makes DMT so powerful" (p. 40). Similarly, Homan states, "Dance/movement therapy provides compelling resources for both the clinician and the patient, and neurobiology helps us understand both its value and potential more deeply" (p. 95). Likewise, in an article testing how different people's emotions are altered when they try to mirror other people's body movements, Allison Winters (2008) concludes her study saying, "The body and the emotions are essential components of dance/movement therapy yet there is little empirical research in the field on the interaction between the two…This is one step towards bridging the gap between dance/movement therapy and other disciplines as well as validating the connection between dance/movement therapy and neuroscience" (p. 98). In other words, the problem the field confronts is gathering empirical evidence, seeing what "makes DMT so powerful," and validating the field through integrations with the neurosciences.

Interessment and Enrollment

The long chain of citations at the end of Homan's first sentence is put forward as a long chain of evidence that the human body is not, in fact, divided from the mind—the

neurosciences now agree with movement therapists. So although bombarded by the rising popularity of a brain-centric neuroscience, Movement Therapy is positioned in a moment of interessement, instead, as being the field that already understands what the neurosciences are just now beginning to discover. Thus, the appeal to neuroscience citations immediately undermines an anxiety that could be brought about by the neurosciences. There is a rhetorical maneuver happening here, in other words, where drawing on the very sources one would expect to stand opposed to the methodological practice of thinking subjectively from the body are positioned as evidence for the movement therapist's valued knowledge of the body. Additionally, by presenting neuroscience citations as already aligned with the actor-network of the field of Movement Therapy as a whole, Movement Therapy articles can then discuss mirror neurons without defending the field-specific interpretation against other possibilities, since, of course, there are no other possibilities mentioned. Put differently, the mass of sources positioned up front can forcefully suggest that all possible sources have been explored and that the interpretation given is the correct and important one. Consequently, the actors are interessed and assigned roles—the neurosciences are made evidential and explanatory to the work of Movement Therapy—and the solution to the problem is to convince other movement therapists to invoke the neurosciences since they can prove that Movement Therapy is cutting edge and important.

This positioning is most potent and evident in Bonnie Meekum's (2010) article. There, Meekums begins with a narrative about the lack of support for Movement Therapy, saying that research publications in Britain are still "sparse," that her own submissions in the field were commonly rejected, and that the field generally "did not meet the accepted

standards at that time for ‘scientific’ research” (p. 35). She goes on to say that various methodologies have been adopted but that the “orthodoxy” of a qualitative approach in Movement Therapy is “fueled by a reactive backlash to the experimental paradigm and a fear of science” (p. 35). This is where she makes the claim that “dance movement therapists, the Robin Hoods of the therapy world, sometimes mistake the King of scientific inquiry for an evil sheriff” (p. 35). She elaborates on the metaphor by explaining how the field has much difficulty mobilizing its work into a statistically analyzable framework and has historically relied upon narrative experience witnessed only by the therapist; as a result, the field has discarded large empirical evidential approaches and viewed them as untenable or unable to be taken seriously. In particular, Meekums highlights some less-than convincing experimental studies wherein “the variables chosen are the easiest ones to limit and may not be the most important ones in affecting the bias of the result” (p. 36). The problem here—one distinctly organized through the author’s personal narrative of Movement Therapy’s position in the academy—is one about Movement Therapy not looking enough like the sciences and not being accepted. Coupling this therapist’s subjective narratives with neuroscientific work is, consequently, positioned as the solution (p. 38-40). Mirror neurons can, if shown to have clear and undeniable alignment with dance therapy, serve the function of convincing therapists to engage the sciences. Indeed, mirror neurons are used in this article for exactly this purpose—as evidence of the potentials for using data from the neurosciences. Meekums states,

> objectification of the body through scientific study offers powerful evidence for DMT [Dance/movement therapy]. This growing evidence base includes the following

> revelations: empathetic communication is characterized by movement synchrony and movement mirroring (Condon & Sander, 1974; Gallese, Eagle, &Migone, 2007; Ramseyer & Tschacher, 2006; Scheflen, 1964; Trevarthen, 2001; Trevarthen & Aitken, 2001); mirror neurons play an important part in empathic communication (Berrol, 2006; Chartrand & Bargh, 1999; Iacoboni, 2008; Meekums, 2006; Rizzolatti, Fadiga, Gallese, & Fogassi, 1996).” (p. 38)

Again, the long train of sources is used here to show alignments between the two fields. And the long train effectively elides differences across types of sources and interpretations advanced in them. Yet, the translational point remains the same—mirror neurons are being assigned the role of solving the problem that has been introduced from a perspective “inside” Movement Therapy, and mirror neuron spokespersons are now being interrelated with movement therapists in a way that makes the neurosciences seem mutual, complimentary, and inseparable from the field. Thus, mirror neurons serve to evidence the argument at hand while being, simultaneously, interpreted through the pre-existing beliefs motivating work in Movement Therapy, i.e. that “empathetic communication is characterized by movement synchrony.”

As another example of this process, Theresa Schilhab (2007) in her article on the meaning of “interactional expertise” sets out to determine how it is possible that a person who has completed a task and a person who has never completed that task can speak equally as fluently about a topic with little language variation (p. 741). Schilhab realizes that Movement Therapy, privileging the body as intimately connected to the brain, should take the position that doing something with one’s own body would make a difference in the

languaging of it. However, this does not seem to be the case, so she uses the research on mirror neurons to solve the dilemma. In the process, she turns to the neurosciences to understand what is "really" happening as the body moves, but she does so by arranging the neuroscience in such a way that it is already on a trajectory toward supporting the assumptions of Movement Therapy. She states, "increasing amounts of evidence obtained at the neural level indicate the involvement of bodily experiences in tasks previously interpreted as purely cognitive. Imitation phenomena produced by the newly discovered 'mirror neuron system' might explain the observed leveling out of variations in language caused by different bodily experiences" (p. 741-742). Here, the first sentence confirms alignment between the neurosciences and Movement Therapy, and the second sentence proposes a neuroscientific solution to a logical dilemma facing Movement Therapy because of its assumptions. Ultimately, the article concludes that mirror neurons could lead to a deeper understanding of this issue and that basic assumptions about the brain-body interaction are, in fact, still valid and shown to be so through the neurosciences.

Here, as the problem of Movement Therapy is defined, neuroscience sources and human actors from Movement Therapy perform a moment of enrolment where they are assigned roles—to solve problems through a complimentary support scaffold—and interrelated as spokespersons and evidence. Consequently, mirror neurons are interpreted as a direct embodied correlation between two human beings. In brief, to confirm mirror neurons as revelatory to "what makes DMT so powerful" and to suggest that mirror neurons productively align with the mirroring practices of movement therapists, mirror neurons *must* be interpreted as a direct "mirror" simulation in the brain. To say otherwise risks alienating

an audience that is, as Meekums puts it, “fearful of science” (p. 35) or risks losing the audience with thick, complicated explanations.

To fully understand this process of interpretation, it is important to recognize that using mirror neuron sources to evidence a phrase like “empathic communication is characterized by movement synchrony” (Meekums, 2010, p. 38) is a specific choice, an interpretation of a neurobiological finding that takes place inside of a functional magnetic resonance imaging scanner where the test subject is immobile and where the result being discussed is based on a computer re-presentation of the movement of oxygen in a micro-thin slice of the brain over a split second of time. In other words, the question is not what the interpretation entails but why it was the one chosen. This question can be answered when the reader of these articles recognizes that the established problem is one of needing the sciences for increased legitimization, needing a way to solve problems not easily solved with a therapist’s observation—that is, needing a “real” understanding, not a subjective personal one, of the processes and power of movement therapy.

For instance, at one point, Homan states, “This article explores specific concepts in neuroscience which help us to understand the interrelationship of the functionings of mind and body and discusses how these concepts can help dance/movement therapists understand, articulate, and engage in our work in a more specific and nuanced way” (p. 81). By suggesting that the article is designed to help other movement therapists to discuss and “engage” their work “in a more specific and nuanced way,” the author indicates that movement therapists are not currently “specific” or “nuanced” and that the data of the neurosciences brings additional specificity and nuance (p. 81). The therapist, not being able

to peer beneath the skull, is presented as not capable of fully comprehending what is happening such that narrative reports of patient improvement do not explain how or why therapies are effective. The use of the word “actually” in the following sentence makes the point as Homan ends her introduction by stating, “But how do body-based interventions actually accomplish this [alleviation of mental states]” (p. 81)?

Overall, these articles point to a cognitive neuroscience finding about a few select neurons in the brain to argue the importance of the body in brain-body interaction, to celebrate Movement Therapy’s existing knowledge of the body-brain tie, and to argue for the necessity of using the hard sciences in the field. This strategy is not called into question because there is a mutually reinforcing effect occurring here where the field is able to find alignments with a neuroscience finding through a common language of emotions and mirrored movements, on the one hand, and then, on the other hand, is able to position secondary cross-disciplinary sources written by important field-specific actors like Ledoux, Hart, and Porges as equitable to neuroscience studies specifically about mirror neurons.

However, despite this process, in many cases, perceived commonalities in the language break down and the mirror neurons of Movement Therapy end up looking quite different from the mirror neurons of the neurosciences. Even though both seem to be talking about the same thing, a closer inspection reveals the extent of the differences. Science and Technology Studies scholar Lucy Suchman (2005) describes this process, explaining how networks of associations construct conceptions of Things, but sometimes those associations require disassociations to maintain themselves; although associations often bury the

disassociations, some relevant disassociations can be difficult to ignore and can, in turn, expose how the associations re-make the Thing (p. 379).

This is the case here. For instance, at one point, Winters states, "The current study [Winters' own study] questions whether emotions that we associate with body postures change whether we watch a person model postures or if we embody the postures ourselves. Recent research on mirror neurons suggests that there is no difference; observing engages the same neurological processes as embodying does (Gallese, 2005; Iacoboni, 2008; Rizzolatti, Fogassi, & Gallese, 2001)" (p. 85). Although this is one place where two of the three sources used in the citation are primary mirror neuron studies and not commentaries or secondary interpretations of findings, the interpretation Winters advances is a bit odd since it assumes experiential identity and does not resonate with the sources cited. In other words, by saying "there is no difference" Winters asserts a strong version of the direct matching hypothesis that argues for embodied correlation much like that seen in Group Analysis when the mirror metaphor permeated those discussions. But none of the sources used as evidence here make this strong of a claim. Seeing someone do an action is not reported in these sources to be experientially the same thing as doing the action. Even Rizzolatti—one of the biggest proponents of the embodied simulation theory of mirror neurons—recognizes that doing the action enrolls other processes and that mirror neurons themselves only usually have a general similarity—what is called a "broadly congruent" similarity—when they are seen firing (Rizzolatti & Singaglia, 2010, p. 271). In short, although the study that Winters herself conducts, wherein participants are asked to mirror each other's body movements, seems to have linguistic alignment with the discussion around mirror neurons, the mirror metaphor is a

way of building associations between the two actor-networks but ends up confounding the issue and blurs important distinctions.

Mobilisation

The network arranged in these articles is sufficiently protected from disintegration or re-arrangement in a moment of mobilization, specifically when the articles asking other therapists to adopt "scientific" approaches address potential contentions. Meekums, for instance, says, "In privileging the discipline of the body over the discipline of the mind, dance movement therapists could be accused of falling into the same Cartesian trap as the dominant discourse in which mind is seen as superior to the body" (p. 38). Here, Meekums argues that qualitative work can and should remain integral to reporting practice in Movement Therapy because it is a different "way of knowing" (p. 38). Thus, Meekums defends the article against attack but also, in the process, protects the new actor-network of Movement Therapy insofar as the neuroscience research on mirror neurons is providing support for this new actor-network that can, in her conception, engage science fairly easily due to existing alignments while remaining "true" to its qualitative tradition.

As if to further strengthen the moment of mobilization, Meekums later tells a personal narrative from her own time as a therapist where she used body movements to help a young 29-year-old boy battle a personality disorder after a long and serious history of sexual abuse (p. 39-40). The story performs her message that movement therapist can turn to the neurosciences for evidence and still use their own personal narratives of change as evidence that compliments what the neurosciences confirm scientifically in empirical data. In this way,

like two other articles that at some point also tell a personal narrative while also arguing for and arguing from the neuroscience, she enacts a moment of mobilization that solidifies the message.

And the message is solidified, in a different register, through the movement of the personal experience of the therapist out into the world represented by the evidence of the neurosciences. In other words, if mobilization, in Callon's terms, is about securing a network by hooking it together with larger actor-networks that can provide stable alliances, then the foregrounding association with the neurosciences in citations, as an act that can be considered on its own, can also be considered a true moment of mobilization insofar as it takes what is private and explains it through popular neuroscience research made public; it takes what is interpersonal—therapy practice with individuals—and makes it universalizable; it takes what is said to be subjective and roots it in what is said to be objective.

All in all, what can be said about the field of Movement Therapy is that it turns to the neurosciences for legitimization and for support, that it organizes brain research and mirror neurons as actors that lend a new and different kind of evidence to the brain-body interconnection residing as the central premise of Movement Therapy, that it tends to mix diverse sources in the event of evidencing itself, and that the interpretation of mirror neurons produced as a result is strict and narrow.

Robotics

Compared to Group Analysis and Movement Therapy, the field of Robotics stands out in the data analysis as having very different discursive features. The sampled articles from Robotics show individual human researchers in the actor position only 2% (N=28) of the time compared to Group Analysis at 20% (N=204) and Movement Therapy at 9% (N=115). Robotics also relies on non-human actors more than any other field, having data as an actor 20% (N=276) of the time and technology 11% (N=156); no other field shows either of these actors more than 2% of the time. Additionally, Robotics deploys the highest number of brain science sources (N=81), but in terms of total citations, wherein one source could recur multiple times, the field varies; as discussed in Chapter 4, differences depend on whether an article is arguing for an extension of practice or completely overturning existing models. The articles overturning existing models use fewer citations than those with a weaker direction of claim (See dissertation Chapter 4), seemingly because arguing for a revision of a model in this Robotics engineering context requires more discursive work and citation evidence than asserting one is not very strong or efficient and then providing a nice replacement. Overall, though, Robotics articles use the most citations from primary brain sciences sources (N=94). Further, the articles in this field qualify statements about the brain or mirror neurons less than any other field. What results is a discourse that is techno-centric, largely drawing on primary sources about mirror neuron studies, and certain about its claims.

The initial question, then, is why Robotics stands in such sharp contrast to Group Analysis and Movement Therapy, which both have discourses that are human-centric, lacking reliance on primary sources, and dotted with qualified claims.

The texts indicate that Robotics, as a field, turns to the neurosciences for biological models for the development of new robot systems. In fact, all six articles sampled from the field argue for some kind of extension or change of practice in the development of robots, to varying degrees. For Robotics, the neurosciences are a mode of invention. Robotics does not seek to use studies about mirror neurons to legitimize the field as a whole, as Group Analysis and Movement Therapy often do. The impulse, rather, is to use the neurosciences as a way of modeling a specific robotic system or of revising existing models. Thus, immediately, the discussion of past human actors like field researchers or theorists, seem to take a back seat to a discussion of the computational models. In this way, the discourse becomes techno-centric, about building systems, and about proving their performance. The hedging almost naturally involved with a discussion of theories and theorists that remain under contestation is displaced by the seemingly objective materiality of neurons that must quickly transform into a reliable mathematical inscription that can guide connections, cameras, and grips for robots.

As an engineering field, in other words, Robotics approaches studies about mirror neurons as functional and mathematical descriptions of information systems. Mirror neurons studies are, consequently, cited as evidence of a particular functionality that can be juxtaposed with existing models of robot perception such that the mirror neurons, once conceived algorithmically, are pursued for their human-likeness and presumed efficiency. This algorithmic representation is the obligatory passage point through which

problematisation occurs. The funneling, so to speak, of mirror neurons through algorithmic processes makes mirror neurons mobile, able to be moved into Robotics. As Computational Neuroscientist Thomas McKenna (2003) notes, cognitive neuroscientists are prone to use computational approaches and emphasize biological realism such that "possible computational models should be constrained and informed by biological properties of the cortex" (p. 193). Robotics finds alignments with the cognitive neurosciences for this exact reason, hoping to build computational models fitting to their robots under the assumption that findings from the neurosciences offer powerful and efficient models easily transferable, as computations, to Robotics.

Yet, the fundamental challenge to Robotics, as roboticists Inamura et al. (2004) make clear, is simplifying human complexity so that it can be actualized in a robot. Inamura and colleagues do this by thinking specifically about smaller systems that might be able to achieve complexity in a simplified way and act from basic structures, similar to how the human brain is believed to achieve complexity with distributed connections (p. 363-364). Thus, what proves compelling about mirror neurons for Robotics, in particular, is that mirror neurons "fire when the subject observes a specific behavior and also fire when the subject starts to act in the same manner," and as a result, "the behavior recognition process and behavior generation process are combined as the same information processing scheme" (p. 364). This combined process appeals to roboticists building perceptual systems that should be both efficient and human-like in their capabilities.

The take-away here is that mirror neurons quickly transform into a computational model, and it is this model, not the human body or the neuroscience studies, that does work

within an argument whose aim is to prove that modeling mirror neurons will achieve complex hand grasping actions in ways not realized in old models. In other words, the new computational model built from the *idea* of mirror neurons appropriately interpreted such that it can be successfully and efficiently mobilized in a robot is what makes one robot better than another. Mirror neurons undergo a transformation or, as Latour describes it, they become an inscription; they are moved from one domain to another by being made into a model. At this moment, "We have been led into a labyrinth" (Latour, 1987, p. 67) wherein "Nature"—mirror neurons, in this case— has been given visual display as a representation so that it can become an actor in another locale.

Because of the need for mirror neurons to transform into something reliable—in this case a computational model—the articles in Robotics appeal largely to primary mirror neuron studies to stage the appropriate idea of mirror neurons and describe how they "actually" function. From there, the articles depend upon the computational model to do the acting, moving from the arguing for the "correct" idea of mirror neurons to the model itself for testing the robot and proving the whole strain of argument.

What is witnessed in the sampled articles are a series of translational processes that start with defining mirror neuron research as the certain solution to a problem of poorly working robotics systems and then interrelating past Robotics models and available neuroscience-based interpretations of mirror neurons to evidence one model over the others. At the end of each article, the new model is secured in a moment of mobilization through a demonstration of its superior efficiency—a strong assertion of "fit" that keeps the actor-network held together and presents the model as a better Standard for the world of Robotics.

What will also be explored in a discussion of this translational process is just how the conception of mirror neurons in these articles is tied to the design of the new model and how the subsequent performance of that model is, in turn, validated by mirror neurons. In other words, the success of the model is declared to be the result of the efficiency of "Nature," once "Nature" is modeled, and "Nature" is, then, confirmed by the working of the model. This mutual, back and forth reinforcement is itself, perhaps, the ultimate moment of mobilization since declaring "Nature" unites the model and the world.

Ultimately, mirror neurons take on mechanistic meaning across these articles, representing connections between the eye and the hand. In these articles, mirror neurons are not an affective mirror. They are a mechanism, sometimes described in terms of simple mirroring behaviors and sometimes described in terms of movements that can be stored in the brain as symbols because the brain's visual processing of a motion is the same processing that can later tell the robot's hand to repeat the motion—the motion and the symbol for the motion are, in these cases, computationally the same with the only difference being the interjection of an inhibitor for the action when the action is being viewed. Thus, the "mirror" aspect in these articles is the ability to use a single system for two acts—seeing actions and doing them. In human terms, the mirror aspect is the ability to symbolize or match in the motor cortex what others are doing, saying nothing, of course, about affect or about embodied resonance. For Robotics, mirror neurons are cognitive associations, a way of being wired.

Problematisation

Giovanni Tessitore and colleagues (2010) in their article, “From motor to sensory processing in mirror neuron computational modeling” exemplify each step of this translational process. They enact a moment of problematisation by appealing to mirror neuron research as the way to develop a new computational model, assuming a problem with old models and an acceptable disciplinary method for finding new ones. They then lock the mirror neuron research that they cite into the role of supporting the new model and standing opposed to the old models because of the way mirror neurons are said to “really” behave. The mirror neurons, and the specific articulation of their behavior, allow them to be appropriated into Robotics since this is what facilitates the new algorithmic design of the robotic model. Finally, the authors enact a moment of mobilization, arguing that the model works and works better than others.

The first line of Tessitore’s article reads, “Mirror neurons exhibit the special behavioral property of becoming active during both execution and observation of object-directed actions” (p. 471). Quickly cited are two founding mirror neuron articles from 1996, one from Vittorio Gallese and one from Giacomo Rizzolatti. The authors then go on to say, “According to a prominent interpretation, mirror neurons are involved in a circuit of cortical areas—usually referred to as the mirror system (Cattaneo and Rizzolatti 2009; Rizzolatti and Craighero 2004)—subserving the control of one’s own actions and the recognition of observed actions” (p. 471). The moment of problematisation is, thus, enacted through what mirror neurons “exhibit”—behavioral properties—as well as through arguing that the “prominent interpretation” is that mirror neurons link the motor cortex to observed actions.

The unspoken assumption is that mirror neurons can and should be used to formulate a new computational model, that they are “a circuit” and that the mirror neurons, herein arranged as the main actors in these clauses, demonstrate specific behaviors that prove that the problem with older robot models is with a wrong interpretation of the neurons.

Interessment and Enrollment

As mirror neurons are positioned as actors that support one computational model over another, interessement takes place. Positioning computational models as two actors in opposition and unable to be reconciled, the article appeals to mirror neurons themselves as arbiters, using the attendant citations as actor-networks of support in a moment of enrolment for what mirror neurons are said to be and to do. This process can be seen in the following passage where Tessitore et al. move from pitting the models against each other to appealing to mirror neurons. They state,

> Various computational models have been advanced to account for mirror neuron functional roles in the broader context of mirror system functionalities (see Oztop et al. 2006 for a relatively recent review). Typically, these models construe mirror neuron behaviors as the outcome of computational processes. According to these models, substantive computational work is carried out by the visual system, and mirror neuron behavior occurs as a side effect as view-independent visual classification abilities. A tension occurs between these computational accounts and the direct matching hypothesis (Rizzolatti et al. 2001). (p. 471)

In this passage, models become actors and mirror neurons arbitrators. Older models "construe" what is argued to be the "real" behavior of mirror neurons, which is outlined in the direct matching hypothesis. The author then presents more evidence in favor of the direct matching version of mirror neurons. In other words, mirror neurons support the new computational model in ways similar to how mirror neurons supported the entire field of Group Analysis. The neurosciences, and often the neurons themselves, are positioned as if they decide why one way of proceeding is better than another. The difference between Group Analysis and what is happening here, of course, is that mirror neurons are being used to judge between specific models for robots, not between whole methods or field-wide concerns.

Despite these discursive practices, mirror neurons, quite clearly, cannot speak for themselves. Neuroscience citations are used as a scaffold of support for what mirror neurons "really" say, and the citations deployed in Tessitore's article are commonly cited mirror neuron studies shared by other articles in the Robotics text sample. In fact, most citations associated with what mirror neurons "are" point to older, founding studies to establish some legitimacy of interpretation. Of the first four citations used, three are by the same researcher—Rizzolatti—and three could be considered founding studies or first studies on the topic discussed. Each of these studies is used in other Robotics articles. The fact is interesting only insofar as every Robotics article argues for a slightly different version of how mirror neurons can or should be configured as a robot's visual-motor processing system, revealing how specific citations do not matter in the translation of mirror neurons as much as why those citations are enrolled and what argumentative work they are made to do, what role

they fill in the translational process of constructing a new actor-network. This is a point addressed later in this section.

Before proceeding further with a discussion of the remaining translational processes, however, it should be noted that the direct matching hypothesis in the Tessitore article does not refer to the direct embodied correlation hypothesis picked up in Group Analysis and Movement Therapy. The direct matching hypothesis merely suggests, "mirror activity is hypothesized to code for motor information which is supplied to the visual system for the purpose of interpreting sensory inputs" (Tessitore, 2010, p. 472). Put simply, direct matching means that the processing happening in the motor area of the brain *is* the understanding of the action. "Direct matching" does not refer to "mirroring" of brain systems between two bodies, but, rather, a "matching" between the motor neurons and the ah-ha moment of the viewer who "owns" those motor neurons. For a robot, this means making the signal to move an arm the same as the signal that codes that arm movement in another body.

Further, it should be noted that despite the language of "hypothesis," the article offers no indication that the "direct matching hypothesis" is anything more than a hypothesis in name. Outside of suggesting other mirror neuron models "construe" the actual functioning of mirror neurons, Tessitore et al. come right out and say, "The functional role of mirror neuron activity during action execution is identified here with a crucial component of the action subspace selection process" (p. 472). Saying that the functional role "is identified here" points toward the article's upfront demeanor about the way it will make certain claims about mirror neurons and the way it could, then, form a conclusion that states, "This approach to action representation is coherent with experimental data on F5 neurons in general, and F5

mirror neurons in particular…motor information coded by mirror neurons is a simplifying factor in action control processes" (p. 483). In other words, the authors are arguing that other models are not "coherent" or simple enough to be modeling the real mirror neurons. In terms of the authors' argumentative strategy, this claim might have less to do with the "coherence" of the model itself than with a belief circulating beneath the claim—that Nature must be logically coherent from a human perspective rooted in the field of the neurosciences and that the new robotics model that the authors are putting forward matches Nature and reflects Nature. Consequently, what mirror neurons become, for Robotics in this case, is a Natural model of efficiency. As such, that mirror neurons can be modeled in a way requiring fewer connections than an older model gives the authors room for making their final claims with certainty.

Interestingly, the value that Robotics articles place on efficiency and simple human-based systems seems to dissuade computational models from seeking murkier, more complex notions of cognition. In other words, mirror neurons appear to be appealing because of the simplicity of their function and the subsequent power of that simplicity, interpreted as the prime cause of highly complex social phenomena like imitation and identification. It is understandable that Robotics would seek after simply systems that can enact complex tasks; however, there does not seem to be any a priori reason to associate this particular case of simplicity with Nature, except that the neuroscience articles claim to describe Nature. Nevertheless, interessing mirror neurons with Nature and Nature with efficiency makes a strong case for the new robotic model.

Indeed, the subsequent tendency toward certainty is reflected in the language as the article transforms mirror neurons into a new robotic model. Mirror neurons, as biological entities, drop away, and the language of models, processes, and systems progressively take over. By the second section of the article, mirror neurons are an "activation of computational steps" or the functioning of "a motor system" (p. 473). Ambiguity disappears and certainty takes over in correspondence with the language of computation.

But the language of certainty that treks along with discussions of computations may have its own reasons and consequences, which have been documented. Psychologist and ethnographer, Anne Beaulieu (2002), for example, argues that brain scientists discuss images as "pictures of numbers" to reject the un-authoritative epistemological position of the visual and identify with the epistemological privilege of mathematics (p. 57). She states, "for brain mappers, the visual is a nonstarter… The visual as problematic should be understood in relation to a tradition that orders types of evidence hierarchically in modern Western science" (p. 57). Similarly, sociologist Kelly Joyce (2005) explores how physicians "position MRI narratives as objective knowledge" (p. 437). They do this, she argues, by "bringing together aspects of physical bodies and cultural, social, and economic factors in unique and locally specific ways" (p. 438). In her view, the tropes doctors use to discuss anatomical pictures "etch together" the physical bodies, the pictures, and the technologies used to make the pictures so that the "human action and values" that influence the interpretation of the pictures disappear (p. 438-439). In the same way, discussing mirror neurons as computations is a way

of making the actions and values informing the interpretation disappear.[25] The language of mirror neurons as computations is not solely advancing an engineer's goal of building a new robot; it is also working rhetorically to endow epistemological privilege and advance the engineer's objectivity and authority, grounding a claim and enabling arguments about computations to be the same as arguments about the biological functioning of brains.

The computational language of the field and the need to transform mirror neurons into a computation offers insight into how mirror neurons become what they do. Indeed, mirror neurons mirror the struggle of the field to achieve a specific kind of efficient workable robot. Mirror neurons end up becoming similar to the researcher's goals. This is evident in the strictness of Tessitore's emphasis on "direct matching" of internal mechanisms of eye and hand as being what mirror neurons are principally about; the interpretation is, after all, what Tessitore seeks to improve in his robots. Other possibilities for what mirror neurons might be about, such as predicting what others will do, understanding the goals of people, or developing opinions or feelings about what others are doing, are totally unmentioned and unengaged.

This aspect of the translational process, wherein mirror neurons are interpreted through interrelating robots and neuroscience research seemingly because of a researcher's argumentative goals, can also be witnessed in Inamura's article, "Embodied Symbol Emergence Based on Mimesis Theory." There, too, the article begins with a moment of problematisation accomplished by pitting two models against each other and then, in a dual

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[25] This does not suggest the authors of these articles employ the language of computations purposefully to make their interpretations and values invisible to readers; rather, the authors follow disciplinary writing conventions, and the discourse of the field has this effect.

moment of interessement and enrollment—where actors are interrelated and given roles as a result—the mirror neurons are the arbiters. In fact, the article starts by setting up how past researchers have tackled "the issues between imitation learning for humanoids and human intelligence" and Inamura and colleagues then argue that their model, "a functional realization of the embodied symbol emergence framework, which is inspired by the mirror neurons and the mimesis theory" works better than others because it does not ultimately require the robot to see an action to imitate it (p. 364). In other words, the robot makes symbols out of what it sees and puts them together on its own, instead of doing the larger, harder task of directly "mirroring" or "memorizing the whole flow of basic behavior" by recording other people (p. 364). Thus, somewhat ironically, perhaps, the argument asserts mirror neurons not as direct imitative mechanisms but as symbolization mechanisms (p. 364). Mirror neurons, once again, shift and become, in this case, less "mirror-like."

The irony of building a better visual-motor system for a robot from mirror neuron research and then intentionally rejecting the everyday notion of what it means to mirror another person as the best interpretation indicates just how mirror neurons are interpreted in Robotics through the field-specific goals of the researcher and the values of the field. In Inamura's case, existing systems are too complex precisely because they do not mirror the "real" functioning of the human brain and strive after mirroring models. For Inamura and colleagues, systems that directly mirror movement through memorization fail to work well enough and fail to align with the connective structure of mirror neurons; this is the case because the field values efficiency and human-likeness. Thus, as in the article by Tessitore and colleagues, referencing mirror neurons lends support to the new model through appealing

to what mirror neurons "really" are. An old model and a new model are interrelated, and mirror neurons serve as the spokesperson or support for the new model.

The same progression of interessement and enrolment occurs in an article by Buscarino et al. (2010) titled "Chaotic mimic robots." There, the problem is with past robotic systems not being able to keep multiple robots working together. The aim of this article is to use the concept of mirror neurons to allow groups of robots to mirror each other's actions, to be better than old robots in how they follow each other and become more like each other (p. 2180). Specifically, Buscarino et al. design one robot to use lights to communicate with "observer robots." The observer robots then record the light cues and connect those cues with their motor movements, wheeling left for one combination of flashing lights and right for another. After a while, the observer robots start to move like the originating robot. "In practice, starting from its sensor inputs, the observer robot is able to understand the behaviour of the other robot in terms of its left/right or forward movements" (p. 2182).

Here, the word "understand" does not mean the observer robot understands the goals of the movement; rather, the observer robot "understands" the light signals as commands for its own movement and generates patterns of movement that reinforce types of movement. Thus, mirror neurons are reduced in this article in that they are no longer about symbolization and dynamic "learning" but about reflecting actions, pure mirroring. Again, mirror neurons shift meanings back to the everyday notion of the mirror.[26] In Buscarino's article, modeling

[26] This is an association that is likely much easier to hold together and requires fewer actors to construct the network since it matches the commonsense notion of what a "mirror" neuron would mean. In fact, this turns out to be the case. Buscarino's article requires few outside actors and sources to assert this view.

robots from mirror neuron systems is a connections concern having to do with building up patterns of imitation, not a way to store symbols for future dynamic use when that robot goes off to face a new environment, so it makes most sense to see mirror neurons as primarily enabling imitation. Framing the "Nature" of mirror neurons this way supports the design.

Seeing how these different articles use the same general translational processes but end up translating mirror neurons in reference to their local concerns can be explored in more depth by taking a closer look at the extent of the network in the moment of interessement—when actors interrelate actors in an effort to solve some problem. Put differently, if one were to juxtapose Buscarino's article with Inamura's, for example, the sheer number of actors involved in Inamura's discussion of mirror neurons would stand out. Inamura et al. interrelate mirror neuron research with actors representing mimesis theory to argue that roboticists need to build robots that "understand" actions as symbols and as goal-related; their argumentative goal requires a larger network, and when the actors carried into the network are interrelated to address the problem at hand, the meaning of mirror neurons changes in accordance with them. It almost certainly must change because those actors are somehow important to the problem that mirror neurons raise and, more often than not, they are carried into the network to explain or re-position mirror neurons in relation to some field-specific entity, like a robot.

For Buscarino et al., however, additional actors are not needed to construct the new network. They want robots to literally mirror each other—not the case at all in work by Tessitore et al. or Inamura et al. Consequently, even though translational processes work the same general way across these articles, the logic of mirror neurons shifts once again in

Buscarino et al. back to the direct embodied correlation hypothesis witnessed in Group Analysis and Movement Therapy—mirror neurons become things that make people, and robots, literally mirror each other. In this way, it necessarily makes sense that the mimic robots follow the movement of a single robot because their perceptual systems are organized the same way, giving them, in some sense, a direct embodied correlation with each other. What seems important is that they mirror each other to "learn" patterns of movement from each other, similar to how the dancers mirror each other in Movement Therapy to "learn" about each other.

The question, again, is how different logics for mirror neurons develop out of the same translational processes within the same field. And the answer is found in the extent of their networks. Like other articles in Robotics, Buscarino's mirror processes for mimic robots consider mirror neurons as a computational model; that much has not changed, but what has changed is the aim of the model and how it can achieve that aim without mediation by additional actors. Other articles require larger systems of support—more actors must be interrelated and enrolled together to build a new actor-network where mirror neurons can appear relevant to the problem set up in the beginning of the article. Inamura et al., for example, mixes mirror neurons and mimesis theory, attempting to bolster support by aligning those two fields—one neuro-biological and the other cognitive-theoretical. Using work by cognitive philosophers Merlin Donald (1991) and Terrence Deacon (1997), which argues that symbol use and, specifically, language use, caused the brain to evolve, Inamura et al. argues that mirror neurons are defined by ties between brain symbolization and body movement and, therefore, should be used as a model for building robots designed to see movement and make

symbols for those actions. Thus, the emphasis or importance of mirror neurons, once mediated by Donald and Deacon, is that they function to make movement symbolic and allow robots, at any point, to call up those symbols and repeat those movements.

However, in Buscarino et al., there are no mediating theories from fields beyond the neurosciences because there does not need to be. In that article, the literature on mirror neurons is first laid out as if unambiguous and certain, the article focuses on mirror neurons as an imitation mechanism, and finally, the process of building the robot is discussed. The article proceeds thus: "Mirror neurons are neural structures involved in the process of imitation and behaviour understanding… The study of these neurons revealed they have motor and visual properties…Mirror neurons represent today the key element in understanding imitation…Mirror neurons have several applications" (p. 2180). Subsequently, the robots are described and the results of an experiment reported.

In short, mediating factors make a difference to mirror neuron interpretations. In Callon's translational terms, interrelating mirror neurons and mimesis theory results in the internalized symbolic aspect of mirror neurons becoming central. Brenton Faber (2007) describes the general process, saying, "successful transitional argument must coherently link from the existing to the new…various competing discourses eventually aggregate together into a new model, which is represented as a core concept" (p. 5-6). Similarly, in his article on "what written knowledge does," Charles Bazerman (1988) describes texts as "mediating reality" and states,

> each text seems to be making a different kind of move in a different kind of game…
>
> Getting the words right is more than a fine-tuning of grace and clarity; it is defining

> the entire enterprise. And getting the words right depends not just on an individual's choice. The words are shaped by the discipline in its communally developed linguistic resources and expectations; in its stylized identification and structuring of realities to be discussed; in its literature; in its active procedures of reading, evaluating, and using texts; in its structured interactions between writer and reader. The words arise out of the activity, procedures, and relationships within the community. (p. 46-47)

In brief, other articles not mediated to such an extent or interrelated with other ideas, centralize different possibilities for mirror neurons. Although all articles in Robotics seek to build ties between bodies and perceptual systems in robots, the needed outcome of the argument in some articles alters who or what needs to be enrolled as support in the actor-network; this, in turn, shifts the logic of mirror neurons.

Mobilisation

Whatever computational possibility for mirror neurons *becomes* for any given article calling up the "real" mirror neurons, each resulting model must be proved in this engineering field through experiment. Mobilization starts with the movement from human brains to robot brains by making mirror neurons into a computation that works and can be seen to work out in the world and can be adopted. Although arguing in the introduction that the "real" mirror neurons support the new model likely goes a long way toward persuading the audience, disciplinary conventions for robot engineers seem to require a "prove it to me" section that acts as a key moment of mobilization. This moment is not powerful because experiments

with the newly designed robots prove that the designs do indeed work; the experiment is powerful because of what working has already been set-up to mean in these articles.

Within the reporting of the experimental results, mirror neurons operate as actors that validate the results. Another way of saying this is that the results are valid and positive precisely because the interpretation of mirror neurons established in the opening pages, and now reiterated in the conclusion, pave the way for the results. For example, Buscarino et al. open the conclusion section saying, "Mirror neurons are one of the most important and fascinating discoveries in recent trends in neuroscience" and then state,

> they [mirror neurons] are visual-motor neurons that activate either when the monkey performs a given action or when it sees the same action performed by another monkey… The experimental results discussed in the paper show how, after learning, the observer robot is able to synchronize its trajectory to that of the observed robot and how mirror neuron-like properties can be found in the neurons of the trained network. The paradigm of mirror neurons can be thus successfully applied to robotics and, in particular, to the problem of learning how to synchronize the behaviour of chaotically driven robots. (p. 2187)

What the authors do not say is that the neuro-biological finding could have any number of meanings and that their experiment, which is said to verifiably have "mirror neuron properties" and exemplify a singular "paradigm of mirror neurons," is intrinsically based upon one interpretation among many. One wonders if the experiment could have failed. With that said, what these articles have argued for is a correspondence between their models and the "reality" of mirror neurons, so an experiment that fails would be one that also, as a

consequence, disproves that "reality" of Nature.

If robots were designed to repeat actions, to store those actions, and to generate them later, then if the robots did not ultimately do this, would mirror neurons be at fault? The article exemplifies Latour's (1987) Janus head of scientific practice. Latour argues that when an experiment aligns with a representation of Nature, Nature is declared as proven; when an experiment does not align, Nature must be appealed to as the final arbiter. The catch, however, is that science always claims that "the settlement of a controversy is *the cause* of Nature's representation, not the consequence, *we can never use the outcome—Nature—to explain how and why a controversy has been settled*" (p. 99, italics in original). In this case, the success of the experiment is declared to be the cause of Nature's correct representation, not the consequence of setting up one's own representation of Nature.

In his essay, "The Age of the World Picture," Martin Heidegger (1938/1977) fundamentally describes this same knowledge-making self-confirmation in science as the foundational process for all knowing (das Erkennen) in the Modern era, which is characterized for Heidegger by the mathematical calculating of things that causes those things to become mathematic in nature. Heidegger states,

> The projection sketches out in advance the knowing procedure must bind itself and adhere to the sphere opened up. This binding adherence is the rigor of research… something is stipulated in advance as what is already-known. That stipulating has to do with nothing less than the plan or projection of that which must henceforth, for the knowing of nature that is sought after, *be* nature…Only within the perspective of this ground plan does an event in nature become visible as such an event. (p. 118-119)

Here, Heidegger and Latour converge in their critique of big-N Nature becoming whatever it is that a scientific researcher examines through the means and methods appropriate to the activity called "science" in the discipline of that researcher. But Heidegger also points to a deeper problem of knowing—knowing anything, in fact—that seizes on the importance of one's process for knowing. Heidegger suggests that "knowing" in any sense that can be validated in the Modern era must be mathematical knowing. And he struggles with an issue to be discussed extensively in the next chapter, but what he does not explore is how this type of knowing must be performed in language to be known. One must navigate translational processes and, as Bazerman says, shape words, even in mathematical knowing. What the shaping of the words in Robotics does is ensure the results of the experiments by laying the ground-work for the evaluation of those results; the Nature of mirror neurons is credited for the representation of mirror neurons shaped at the start.

This discussion is intended to reveal connections between Heidegger's thoughts, Latour's exploration of the Janus head, and Callon's exploration of the final moment of mobilization. It is not intended to pronounce the end of all knowledge or to situate perpetual deconstruction as ushering even the most pragmatic engineering disciplines into the postmodern abyss. Instead, the discussion foreshadows another in Chapter 6 about the long history of thought about human language as pointing to a reality beyond itself and how that history still informs even the most pragmatic uptakes of the neurosciences today and haunts the field of Rhetoric, even Rhetoric.

Phenomenology

When combining all human actors used in Phenomenology, the field looks very similar to Robotics. Phenomenology uses human actors 8% (N=117) of the time and Robotics uses them 9% (N=128) of the time. Likewise, Phenomenology does not use the brain and mirror neurons very often as actors in clauses, appealing to them only 9% of the time (N=116). Thus, like Robotics, other actors are leading the discussion after the idea of mirror neurons has been set up in these articles. In Robotics, mirror neurons transform into computations after being established; in Phenomenology, they transform into arguments, positions, and claims that mitigate the priority of mirror processes by suggesting that the intersubjective, cognitive Self interferes with the pure processing of neurons below the level of consciousness. In fact, the articles in the sample take a hierarchical epistemological privilege away from the neurosciences, re-asserting their own way of knowing through the experiences of the body. As a result of this emphasis on the phenomenological description from the body and phenomenological arguments about the body, the field produces an important contrast to Robotics: it uses very few brain sciences sources, the fewest of all fields in the sample (N=46). So while Robotics and Phenomenology both organize their discourses through non-human actors and both transform mirror neurons into something else that can do work in the argument, Phenomenology, at some point, turns away from the brain sciences and complicates, if not rejects, its scientific way of knowing.

This difference in the textual analysis highlights the central exigence in these Phenomenology articles—to address and validate the new neuroscience information while re-

asserting a phenomenological perspective. The lack of neuroscience actors and neuroscience citations also highlights the inner-workings of the field's moments of translation. Specifically, the moment of problematisation involves the need to find resolution for the phenomenological perspective in light of the neuroscientific interpretations of mirror neurons, and mirror neurons are throw into question and become strictly theoretical and in need of phenomenological mediation as a result. In this way, the discourse asserts what Latour calls a "negative modality," establishing the problem as one of phenomenologists having to grapple with the neurobiological data from a philosophical point of view that maintains its uniqueness and also requires discussion of philosophers who highly value the materiality of the body but take up alternate positions about how the body's experience interfaces with its own materiality.

Problematisation

Starting by asserting that we all, at some time or another, feel "sympathy" or "co-feeling" with other people, Dieter Lohmar (2006) explains that an analysis of feelings is "old-fashioned," something "which had their time in 17th Century moral philosophy, but not today!" (p. 6). Starting this way suggests that Lohmar is on the defensive, offering a stereotype to his audience about philosophers as a method or means by which to undermine that stereotype and assert the importance of co-feeling. Starting this way also arranges a new problem for the field of Phenomenology, namely that "this kind of hard skepticism [against feelings] may be refuted by neurological findings" (p. 6). This is when Lohmar mentions mirror neurons and states, "I think that this discovery is of eminent importance for the

phenomenological theory of intersubjectivity… The fundamental conviction behind my analysis is that the performances of mirror neurons have an 'internal view,' i.e. they can be experienced by me, and these experiences are accessible to phenomenological description" (p. 6). Lohmar's use of phrases like "I think" and "my analysis" indicates the importance he places on interpersonal reflection, but he also performs a rhetorical maneuver that de-centers the subsequent philosophical discussion from any potentially objectivist claims. In trying to use mirror neurons at the outset to debunk "hard skepticism" against philosophizing from one's own feelings, he then turns around and asserts the "inner view" of the activity of mirror neurons; thus, he takes what is likely an expectation of his audience—that biology offers evidence for phenomena—and uses it to place the entire discussion back into a realm of subjectivity, eventually throwing mirror neurons into question. The moment of problematisation, in short, is for the phenomenologist to assert the validity of the phenomenological way of knowing, which, in turns, raises questions about the objectivity of the interpretation of neuroscientific results. In ANT terms, the inherited phenomenological methods become an obligatory passage point through which mirror neurons as actors must pass.

The same such moment of problematisation can be seen in Marc Slors and Cynthia McDonald's (2008) article titled, "Re-thinking folk-psychology: alternatives to theories of mind." There, the problem is put forward as being about the current overturning of a long history of philosophers accepting a folk psychological notion that people understand each other's feelings and intentions—have "mindreading" or "mentalizing abilities"—as a condition of social interaction and that this ability, in turn, explains social interaction. What

this means for these researchers is that the so-called "Theory of Mind debate" is uncertain, partially as a direct result of mirror neurons. In fact, the article, which introduces a special issue of the journal *Phenomenology and Cognitive Science*, argues that new neuroscience research shifts philosophers toward believing in "social cognition without ToM [Theory of Mind]" (p. 159). However, the article also presents phenomenology as troubling this trend, pointing to several other phenomenological arguments, which show that "such views have difficulties accounting for the phenomenological differences between self and other attribution," and that more traditional phenomenological accounts of person perception may still be central to the ability to engage others (p. 159). The point remains, though, that the moment of problematisation exposes a philosophical debate that wants resolution, that phenomenology seeks to validate the neurosciences while also defending its territory, and that mirror neurons are viewed in terms of their different interpretations because some interpretations stand opposed to a history of thought in phenomenology.

This is perhaps most potently expressed in Helena De Preester's (2007) article, "From ego to alter ego: Husserl, Merleau-Ponty, and a layered approach to intersubjectivity." She begins by presenting "two different phenomenological logics for modeling the constitution of intersubjectivity," one belonging to Husserl and the other to Merleau-Ponty. For her, the initial problem is that the two accounts "profoundly differ in the basic operation leading from ego to alter ego" and that proponents of mirror neurons do not differentiate between the two (p. 133). She, consequently, turns to the "recent mirror neuron theory of intersubjectivity" and argues, "that the mirror neuron theory uses Husserlian as much as Merleau-Pontian logic, notwithstanding exclusive reference to Merleau-Ponty in the literature on mirror neurons" (p.

134). What she calls “mirror neuron theory” is a collection of writings about mirror neurons primarily done by two neuroscientists—Rizzolatti and Gallese—who are credited with much of the development of mirror neurons, and she collates what they say as a “theory.” But what really proves fascinating here is that De Preester does not argue, as past fields have so regularly done, that mirror neurons can step in as the arbiter of the problem in the field and solve it. Rather, she argues that mirror neurons have been ordered as a “theory” that mixes phenomenological perspectives and that the interpretations of mirror neurons need some serious adjustment as a result. Specifically, the re-working that mirror neurons need is the kind that makes them fit easily into philosophical theories developed by phenomenologists.

Essentially, De Preester argues that those putting forward a theory of mirror neurons, on the one hand, want to adopt a Husserlian view where Self and Other in childhood development have two similar bodies both engaged in co-presenting each other’s psychic layer because of the body’s experience of the Other [for Husserl, though, this was done through the human voice and not through sight], but that the theory of mirror neurons also, on the other hand, wants to privilege Merleau-Ponty’s notion that two bodies converge through the visual sensing of an object and are able to “synchronize” through both reaching out to the world, which is accomplished in the body because of the co-role of objects in the outside world in forging perceptions. These are at odds, De Preester explains, because Merleau-Ponty’s view moves away from a rational-cognitive approach still present in Husserl. But more to the point, for Merleau-Ponty, “the objects of action, toward which both I and other are directed, are the mediating terms between ego and alter ego. Correlatively, to imitate is not to do the same as the other, but to arrive at the same result” (p. 137); yet, the

theory of mirror neurons suggests that both bodies *do* imitate, cognitively and neuronally "mirroring" each other, even while Merleau-Ponty seems to argue two bodies do not do this and do not need to do this to "know" each other. The problem, then, is that the theory of mirror neurons confuses two phenomenological theories while touting Merleau-Ponty.

Ultimately, De Preester argues that proponents of mirror neurons are so enthralled with the idea that mirror neurons can account, as a biological entity, for understanding other people's actions that they forget, or overlook, that the action perceived by the viewer is only detectable in brain scanners when "characterized by a goal" (p. 139). She is inherently referencing work by Umiltà et al. (2001) here and then states, "in the explanation of action-understanding the identification between observer and observed (the mapping of a visual image onto a motor schema) prevails; the notion of a goal moves into the background and even disappears" (p. 139). In the end, De Preester's problematisation demonstrates a similar theme across all articles in the Phenomenology sample: they re-assert the importance of Phenomenology—either by practicing it in the open for everyone to read or by explaining its history and debates—and, consequently, they de-stabilize mirror neurons as given by the neurosciences.

Interessement and Enrolment

In Lohmar's article, he positions himself as the actor in the field able to address the problem at hand. For Lohmar, the problem seems to be to re-assert the phenomenological way of knowing while giving the neurosciences some due respect. This is achieved, in the first, by outlining mirror neuron research where mirror neurons are discussed as being

important but also involving some odd curiosities. Here, Lohmar covers work by Rizzolatti and Gallese, recognizing their finding, e.g. that a few select neurons in the F5 region of the macaque monkey brain fire when the monkey views an action as when doing the action. However, Lohmar also highlights lingering questions from studies on mirror neurons. He points out "differences between the two cases of neuronal activity. The activity of neurons in the case of "mirroring" was not as strong as in one's own movement" (p. 7), and he later states, "Likely, the most amazing peculiarity is the fact that mirror neurons become active only if the experimental animal (chiefly macaque monkey) sees a purposeful action" (p. 7). The questions about what these oddities mean for mirror neurons seem intended to prepare the reader for the way he later interrelates himself, the neuroscience research, and the reading audience.

By suggesting, "we may interpret the sense of this 'mirroring' performance of our brain in different contexts" Lohmar moves the discussion of mirror neurons out of the neuroscientific framework for interpretation and asserts another way of going about interpreting the findings. He proposes "the point of view of the single person and his or her own first-hand experience. We might call this kind of sense the 'concrete sense'… In other words, what I want to know is how the experiential side of the mirror neuron's performance is experienced by me, how it shows up, how it feels, how it moves me" (p. 8). In so doing, Lohmar positions himself as the prime actor, as the one able to answer the question of the meaning of mirror neurons and of the state of Phenomenology as a field that is, perhaps, epistemologically under-valued in the discussion of mirror neurons. His direct address of the audience through the recurring "we" voice amid the "I" voice interpellates the audience

(Althusser, 1970) as able to see and agree with his position. To some extent, then, he performs a moment of enrolment here as well by placing readers into the position of supporting his intersubjective account.

Although Slors and MacDonald also often use the words “Our” and “We,” their article is primarily a historical, chronological narrative of the development of the Theory of Mind (ToM), which eventually leads up to a discussion of how mirror neurons call into question the main positions in ToM literature while also suggesting that ToM has, from a phenomenological perspective, its own questions for mirror neurons (p. 158-159). But the fascinating moment of interessement occurs when specific neuroscience researchers, as individuals, are brought back into the discussion to establish the “sides” of the debate and to enable the authors of the article to prove that the problem they set up in the beginning is, indeed, a problem and that the various actors now mentioned need to enroll additional actors to solve the problem, which is exactly what the special issue attempts to do. Slors and MacDonald state,

> The intuitive similarity between the claims made by ST [an approach to ToM called “simulation theory”] and the workings of mirror neurons discovered in the early 1990s led Gallese, one of the discoverers, and Goldman to join forces and argue that neural mirroring systems may embody precursors or primitive versions of simulation routines (Gallese and Goldman 1998). This suggestion, initially leading to enthusiasm among both philosophers and cognitive neuroscientists, has met more recently with considerable skepticism too (e.g. Jacob and Jeannerod 2005; Jacob 2008; Gallagher 2007). (p. 155)

Slors and MacDonald make the point that the initial enrollment of a philosophical ally—Goldman—by the mirror neuron researcher—Gallese—led to acceptance of ST in ToM but that a new actor-network—Jacob, Gallagher, etc.—have started a new group, which to "be made relevant" in scientific practice must enroll more allies than the other group (Latour, 1987, p. 127). Moreover, Slors and MacDonald have also pointed out how, at present, the groups remain at a stalemate or silent. Slors and MacDonald state, "The question whether mirroring should be understood as simulation – or in general whether neural activity associated with social cognition is evidence of simulation or use of a ToM is nowadays sometimes left untouched in this branch of science" (p. 156). In other words, the issue has been left up the phenomenologists or to the future after much more cognitive neuroscience work has been completed. Right now, the introduction to the special issue seems to suggest, phenomenologists need to sort through their differences and try to use the phenomenological way of knowing to lead the discussion about how social interaction can happen without the old assumptions of ToM and to, perhaps, even lead the neurosciences.

A similar translation occurs in De Preester's article. After problematizing what she calls "mirror neuron theory," De Preester outlines Husserl's position, then outlines Merleau-Ponty's position, and then discusses the neuroscientific literature on mirror neurons. In so doing, she reverses what has been seen thus far in all of the sampled articles and suggests a way to "fix" the interpretation of mirror neurons coming out of the neurosciences. On the one hand, she continues the practice of interpreting mirror neurons through field-specific goals, disciplinary history, and concern for the survival of the field, which are certainly themes of this chapter; however, on the other hand, she gives the neurosciences no privilege. By

interrelating the actors one by one—Husserl, Merleau-Ponty, and then Rizzolatti and colleagues—she shows the inconsistency of mirror neuron interpretations from her phenomenological lens, positioning those interpretations as needing to submit to the phenomenological discussion. The philosophers' past discussions, in her view, decide consistency from inconsistency.

De Preester states, "to make the philosophical–conceptual background consistent, a number of particular characteristics of mirror neurons should effectively be used in the explanation of action understanding and imitation" (p. 138). She then offers a solution. She argues that neuroscientists need to take a cue from Merleau-Ponty, whom they so often cite, and explain the functioning of mirror neurons in terms of the objects existing out in the world that organize the neurons firing. Yet, she also argues that Husserl is implied in the interpretation by neuroscientists for good reason, namely because bodies learn from each other and understand each other's movements. Thus, she makes these philosophers obligatory passage points and then suggests a "layered approach" to interpreting mirror neurons, which asserts that humans have "two levels of intersubjectivity," one that contains a "minimal set of requirements concerning the body of the other" that allows people to "recognize that the other has a similar body" and another that responds to how that body moves in relation to the outer world (p. 140). This "layered" solution, in her view, keeps the discussion consistent. But it is only by interessing the phenomenological philosophers and setting them up in enrolment as agents of "truth" that she can claim to uncover a new mutuality that is exposed, in retrospect, by the poor interpretation of mirror neuron research.

Mobilisation

On the face of it, moments of mobilization are sparse in these articles because the question about mirror neurons reaches no definitive solution. There is no conception to move out into the world, although De Preester does offer one. Unlike Robotics, for instance, there is no "prove it to me section" where some design is put on display and shown to be a new model that can be adopted and wrapped into existing actor-networks. In some sense, though, the phenomenological discussion itself "proves it." One on level, mobilization happens throughout philosophical discussions as small textual moves, like saying some past contention has been "taken into account" or saying that X argument is "more consistent," connects past arguments with current ones. However, are at least two other, broader features of these phenomenological arguments that function to secure their new networks. First, the enrolment of well-respected actors like Merleau-Ponty, who in recent times has grown popular in Cultural Studies and in Philosophy of Technology, provides a ready-made securing-mechanism for phenomenological networks when they can connect with large actor-networks now invested in Merleau-Ponty's work. Second, phenomenological arguments secure themselves through an appeal to the body of the individual.

What is unique about this first move—the enrollment of Merleau-Ponty—is the dearth of actors available in the field of Phenomenology that are "house-hold names" in academia. Appealing to Merleau-Ponty, in particular, now brings cache. In addition to having some obvious resonances with the discovery of mirror neurons, this is likely the reason why

Merleau-Ponty's name appears in several mirror neuron texts.[27] Merleau-Ponty's popularity has been expanded recently by books like Mark Hansen's *Bodies in Code*, Andy Clark's *Natural Born Cyborgs*, and Katherine Hayles' *How We Became Posthuman*, all of which, incidentally, deal with increasing human technologization and the extension of cognition out into the world or the blending of cognition and world. But this is not an incidental occurrence. The conceptual realities of Merleau-Ponty's phenomenology, grounded in the reaching out of bodies to the world such that a phenomenological way of knowing through embodied experience is, in his view, most readily explainable from the perception of the body's outside, acts as an elegant bridge to mirror neuron research, a line through which to connect the Humanities and the Sciences, a way to make them appear mutual and compatible and whole, a method of strengthening a network of support.

Merleau-Ponty follows in a tradition that mirror neuron researchers seem to want to follow—one that moves against the liberal humanist framework, which, in the words of Hayles (1999), is characterized by a "possessive individualism" wherein the human is imagined as entirely free from its surroundings (p. 2-3). Mirror neurons expose how the brain performs only in relation to the full perception capacities of the brain-body and what they take in or "see" out in the world. Yet, ironically, mirror neurons can also be said to participate in a tradition of liberal humanism associated with information transference in the brain, ultimately envisioning "the liberal subject" as possessing a body without that subject usually "represented as being a body" but represented as being most significantly and

[27] As an example, see: Gallese, V. (2001). "The shared manifold hypothesis, from mirror neurons to empathy." Journal of Consciousness Studies, 8(5–7), 33–50.

primarily a brain (Hayles, p. 4). In short, a long and increasingly prominent struggle happening in many Humanities and Social Sciences today is one of re-making the isolated individual into a technologized subject, which, today, means making it representative of its technological times—networked, ecologically understood, and able to change as it is mobile. Merleau-Ponty is a potent starting point in the discipline of philosophy, and his popularity, not a mistake of history but a force of history, serves as mobilization for mirror neuron texts as well as for phenomenological texts. Thus, arguing about what Merleau-Ponty meant or could mean does, in itself, secure the network of which he is made a part. If Merleau-Ponty is on your side, in other words, you have a large actor-network of rhetorical alliances in the Humanities.

Discussions in Phenomenology, to the extent that they appeal to the experiences of the body, also seem to secure themselves. Put differently, saying as Lohmar does, that the analysis will constitute "an internal view" protects against charges of being pedantic or of over-extending. How could a person speaking from personal experience be entirely wrong? In another article, for instance, titled "The Co-consciousness Hypothesis," Frédérique Vignemont (2004) begins by asserting that "I have privileged direct knowledge of my own mental states, but I do not have any immediate access to other minds" (p. 97). The position he takes is meant to show a phenomenological problem with mirror neurons—that is, they don't explain how people, if "mirroring" or "connected" in the brain's internal wiring, are individuals who form as Selves and who do not always understand each other (p. 111). Vignemont explores common situations, such as knowing but not knowing why someone else is crying or being able to feel the pain of someone who recently lost a father while not

exactly feeling that pain; he also points out that we might make mistakes about how others feel (98-102). The discussion from common experience allows for a questioning of mirror neurons from a position that is difficult to refute. Further, the appeal to common experience acts rhetorically to move the audience toward a belief in the universality of some idea—humans are separated individuals who have to talk to have identity with each other, for instance—framed as intimate or joint to human experience such that the argument, to some extent, secures itself.

Overall, the discourse in Phenomenology surrounding mirror neurons looks and acts differently than the others explored in this chapter. It does not place the neurosciences in the actor position very often, using the brain or mirror neurons as an actor less than any other field (9% / N=115) and citing those clauses less than any other field (25% of the time / N=21). It, rather, doubts the neurosciences, organizing field-specific researchers as actors (23% / N=320) and centralizing their arguments and claims (argument processes 10% / N=144 and argument claims 18% / N=242); it discards citations in favor of strong philosophizing.

At the same time, however, the articles from the Phenomenology text sample do exemplify a few themes evident across all fields. They express some level of discomfort with the epistemological position of their own field, wanting to legitimize their theories and practices in lieu of the popularity of the neurosciences. They also use field-specific researchers to interpret mirror neurons in a way favorable to their argumentative goals, which, in turn, seem to respond to the exigence of ensuring the survival of the field after mirror neurons create instability in the field's existing theories. Additionally, they tend to

secure the new actor-network of the field by shaping words in ways familiar to the field's specialized writing practices, which value the interpersonal, embodied language of experience.

Observations Across the Text Sample and Reviewing the Analytic Objectives

The discussion of each field's four moments of translation achieves the five analytic objectives put forward in the methodology chapter. Each analytic objective will herein be reviewed, and amid the discussion, the moments of translation from each field will be explored together to highlight how they lend insight to those objectives.

Analytic Objective 1: Determine what kind of translational work is being done in reference to the term "mirror neurons" in the different non-neuroscience fields and whether there are similar patterns of translation across the fields.

In translating mirror neurons into a new domain, two fields rely primarily on human actors, one relies on non-human actors, and one uses human actors to stage arguments. The point proves significant when Callon's moments of translation are viewed as a rhetorical process wherein actors arrange to move some new entity—mirror neurons—into another actor-network in a way that seems to continue that network's discourses and remain relevant. In the cases observed here, the actors translate mirror neurons *in terms of* the field in a way that also reflects the field's epistemological needs. This pattern of making a neuroscience

finding into the field's own image can be first and foremost demonstrated by examining the actors organizing the translation.

For Group Analysis, the field-specific human actors bring with them a history of the field, retroactively define the field of Group Analysis, and interpret mirror neurons exclusively through their pre-existing ideas; all of this is in an effort to bolster and validate the field with a new kind of evidence. For Movement Therapy, the human field-specific actors are interrelated with various neuroscience citational actors such that mirror neuron researchers, popular neuroscience researchers, and Movement Therapy researchers blend together to make mirror neurons appear already aligned with Movement Therapy; consequently, those working in the field might feel less hesitation about explaining their practices with neuroscientific data and might develop new practices through quantitative methods. For Robotics, mirror neurons are transformed into computations and made into reflections of models and systems already known in the field, redefining what mirror neurons mean specifically in terms of the field's values for models and requirements for proof of working models. For Phenomenology, the arguments of past figures in philosophy call mirror neurons into question, making mirror neurons once again into a hypothesis about human experience that can, ultimately for this field, re-establish the need for phenomenological exploration and the priority of phenomenological history.

The analysis of actors starts to reveal the "how" of these translations and indicates a pattern of setting up field-familiar spokespersons as passage points for interpreting the neurobiological phenomena. This specific pattern will be explored in detail in the next chapter as a way toward making specific recommendations for conducting a neuroscience of

rhetoric. But for the time being, it can be noted that the actors mobilized by a field also indicate a pattern in terms of argument outcomes.

For instance, those fields centering human actors as spokespersons most overtly turn to the neurosciences as a means of explanation and legitimization for their fields, whereas fields centering non-human actors as spokespersons tend to use mirror neurons as a mode of invention that, admittedly, serves to reify their fields as well. The exception here, to some extent, is Phenomenology, but the textual analysis of actors suggests that the arguments of the relevant figures dominate the discourse and stand-in for what Phenomenology represents—a history of inter-subjective thought about the body—as it engages and resists the neurosciences' interpretation of human experience developed in a different way. Overall, then, each field moves from field-familiar actors, reflecting their field's history, but they also make arguments that advance their own field's perceived validity in the university.

The verb form data also demonstrate and support this conclusion. Taking each field in turn: the Group Analysis articles use verbs that discuss mirror neuron research as certain, yet they tend to qualify their own field's interpretations of mirror neurons. The data analysis, in this case, reflects a field harboring hesitations about the validity of its own form of knowing. It shows a field turning to the neurosciences for confirmation. This data reflects its translational process; the words used in the articles expose the way the field positions mirror neurons as unambiguously supporting the field's practices right from the get-go. Likewise, the Movement Therapy articles use a single subject and verb supported by a plethora of kinds of citations, indicating a central translational process where boundaries between fields need some eroding. Additionally, the certainty expressed across Movement Therapy articles

suggests a singular interpretation of mirror neurons that *is* the correct interpretation and one that aligns with the body mirroring practices of the field. In a similar register, the certainty of the Robotics discourse, which argues for one interpretation of mirror neuron behavior being "more correct" than another being represented by an old model in the field, reflects an attempt to re-make mirror neurons to fit the engineer's goals and become a working robot that can be, literally, shown to work. The priority of showing robots working because of human neurological processes is, as Inamura et al. (2004) discuss, a value of the field as it seeks to "share research outcomes and hypothesis with human behavioral science" and allow robotics engineers to explain robot complexity with human complexity, something they are currently unable to do (p. 363). Phenomenology's verb forms reflect an opposite predilection; certainty about its own researchers and its overt qualifications surrounding those times when mirror neurons do appear as actors in clauses reflects a translational process intent on re-creating an even epistemological playing field.

This big picture view of the data suggests, most significantly, a central pattern across all fields—each confronts an epistemological dilemma, and each asserts a need to prove its value and workability in addressing human experience in tandem or over and above the neurosciences. For all the evidencing the neurosciences do, then, they also seem to evidence their own hierarchical position in the university and the feeling of the subordination and insecurity within other disciplines resulting from the neuroscience's dominance and popularity.

Analytic Objective 2: Determine the extent to which "mirror neurons" move as a dynamic signifier across non-neuroscience fields, specifically in relation to the neuroscience citations referenced.

Mirror neurons are dynamic. But saying that they shift representations in relation to disciplines is too simplistic and obscures some of the texture that can be brought out by thinking more specifically about what Karina Knorr Cetina (1999) calls "knowledge cultures" evident in the translational movements already identified (p. 2). Although mirror neurons are interpreted as equivalent to mirrors in Group Analysis and Movement Therapy, this is the case because those fields engage their histories and practices in particular ways that lead to this conclusion. The "texture," then, is the particular referents, symbols, technologies and ways of discussing these things so that they are or are not actors that become important to thinking about or from mirror neurons, which ultimately construct sense-making from a culture of practice. That each field has a culture is centrally important, but each field is, at the same time, not so much bound by it as they are always operating out from it and re-assembling it in the translation process.

Robotics, for example, certainly reflect a specialized knowledge culture that moves from past models, is concerned with particular technologies, has specialty language, and symbolizes outside objects of study from other disciplines in those terms; however, the "reality" of mirror neurons in the field still manages to display dynamism. Different Robotics articles assert different conceptions of mirror neurons, and each article argues that its own conception is the "correct" view of the true "Nature" of mirror neurons. But it seems to be this exact pattern in the knowledge culture—that models should reflect "Nature," for various

reasons having their own historical precedents—that enable this dynamism. Similarly, it is a knowledge culture that foregrounds embodied experience that makes the field of Phenomenology what it is, so the fact that singular and objective declarations about the ontology of mirror neurons are questioned or outright rejected reflects that culture.

Any dynamism seems, however, to be constrained by the neurosciences, their studies and forms of engagement with materiality. In other words, mirror neurons do not become anything at all. They are interpreted specifically in a range evident already in the Chapter 2 discussion of the history and development of mirror neuron research. Each interpretation witnessed in the sampled fields draws on some other theory promoted at some point in the neuroscientific literature. Whether any given article in any given field could shift its interpretation and adopt an entirely different one also put forward by a neuroscientific article is, however, unlikely. This is because the goal of the article, situated and operating from its knowledge culture, would simply disable the argument. For example, if any of the Group Analysis articles recognized that mirror neurons only fire in response to particular goal-directed actions, then saying that seeing one's own Self "reflected" back by the Mother is at the center of a developmental process happening through mirror neurons would likely be pushing the envelop or be unfounded; the history of the field would be disbanded and its way of reasoning from psychoanalytic theories would not function and could not make the neuroscience "fit." Likewise, saying that an understanding of others happens because of mirror neurons and that mirror neurons are responsible for empathy formation and can support the group psychotherapy practice of mirroring facial expressions might be too ridiculous if mirror neurons fire only around specialized goal-related events, even though the

practice itself might still prove therapeutically effective; in this case, too, mirror neurons must be made to "fit" the knowledge culture.

What this indicates is the boundaries of possible interpretation are constructed by the neuroscientific literature as it is endowed with epistemological priority over other "outside" fields but that the possibilities for dynamic translations increase as studies increase, as citations become readily available, as controversies emerge, as differences expand, and as some interpretations resonate with actors familiar to another field. Each "outside" field is, thus, able to frame its own connections and make its own claims backed by neuroscientific sources. Whether those claims extend across multiple sources or whether they can stand the test of scrutiny and time is another issue all together. Indeed, it seems as if several of the articles discussed in this chapter will, as Latour (2005) says, "pay the price" for their way of operating, for neglecting alternate interpretations that may undo their own assemblies (p. 35).

Analytic Objective 3: Determine whether the strength or the direction of an article's claim is a factor in the way mirror neuron research is translated across non-neuroscience fields.

This proves to be a difficult question to answer outright. In other words, fields with strong, certain claims and with changing directions that could overturn existing theories and practices are also fields with their own disciplinary histories and writing practices. The same is true for the fields with weak claims and supporting directions. Robotics, for example, shows the strongest inclination to overturn existing field-specific models, but their way of writing about robots—through discussions of data, technologies, and computational processes—disables a clear-cut analysis of the sole impact of the strength and direction of

their arguments on interpretations of mirror neurons. The strength and direction of any argument, in other words, are likely related to mirror neuron interpretations only in direct relation to the broader network—the other material and discursive forces aligning actors and making the new research "fit" into the field in question.

With that said, the data suggest that articles making certain concluding claims but having a supporting direction for their claims—that is, raising less challenges for the field—tend to interpret mirror neurons in a less complicated way. Group Analysis and Movement Therapy, for example, both strive to position mirror neurons as support for their existing theories and practices, and both narrowly or stringently define mirror neurons as literal mirror mechanisms in the brain. Although Movement Therapy drew on a large amount of direct mirror neuron sources, the meaning of mirror neurons as a biological entity was still singular. Robotics, on the other hand, showed variation in possible interpretations asserted across all articles in the sample, complicating the matter a bit. Phenomenology, likewise, raised numerous possibilities for mirror neurons and did not congeal around a singular version of mirror neurons. However, this observation should be measured against the recognition that Group Analysis and Movement Therapy both hold the mirror metaphor central to their theories and practices; so it remains inconclusive in this study as to whether the strength and direction of the argument was a key factor in neuroscience interpretation or not. In brief, although it could be said that some fields interpret mirror neurons in a less complicated way and those fields tend to have supporting directions for their claims, it seems likely that strength and direction are enabled, propped up in the first, by the mirror metaphor and the expected ways of writing and presenting evidence in particular fields of study.

Analytic Objective 4: Determine whether time is a factor that makes a difference in the way mirror neurons are translated.

Because most fields relied upon older mirror neuron sources to make their primary claims about mirror neurons as well as relied upon secondary sources to bolster those claims, time is and is not a factor. Time is a factor insofar as older mirror neuron sources are commonly used to put forward an interpretation of mirror neurons; the only recurring sources across all fields were these older, "founding" mirror neuron studies. That these studies are a factor is primarily because they tend to interpret mirror neurons as direct embodied simulations, as neurobiological mirrors, seemingly prompting articles to adopt a similar interpretation, especially articles that do not reach out further into the neuroscientific literature and have no other reason for adjusting or questioning that interpretation. However, not all articles across all fields do, in fact, adopt that direct simulation interpretation, so time is not so much a factor, at least when compared against the field's reasons for turning to the neurosciences and for making the kinds of claims they make. Time also is not a factor insofar as most of the articles in the text sample also deployed secondary mirror neuron sources published later (see figure 4.4 and 4.5 in Chapter Four). In other words, because articles across all fields and all argument strategies drew upon older mirror neuron studies and newer secondary sources, time of neuroscience sources cannot be correlated to mirror neuron interpretations in any significant way.

The same is true when considering the time of publication for the field-specific articles themselves. For example, Phenomenology contained the oldest articles (2004, 2006, 2007, 2008, 2008) compared to Group Analysis and Movement Therapy, which both had two

articles from 2010; yet, Phenomenology called mirror neurons into question and presented numerous options for interpreting mirror neurons. One might expect the newer articles to do this since the most skeptical mirror neuron articles appeared after 2008. Yet, as explored in this chapter, Phenomenology had good reason to question mirror neurons, and Group Analysis and Movement Therapy had good reason not to do this. Thus, although secondary sources clearly increase across the entire text sample as time goes on, showing that mirror neurons concretize and, perhaps, encourage the arrangement of a positive modality wherein their functioning cannot be easily called into question, date of publication seems less important to the translation of mirror neurons than the established disciplinary history, the need to turn to the neurosciences, and writing expectations in a field as it constructs knowledge in journal articles. If the translation of mirror neurons in a field is viewed as a problem, in other words, then the problem is institutional and systemic, not individualized. The problem is one of disciplinary competition in an epistemological hierarchy now increasingly dominated by the brain sciences, one of needing interconnections with the brain sciences for legitimization or, alternately, needing to reject the brain science's dominance to maintain the field. The problem is consistent failure to pursue multiple neuroscience possibilities that do not serve a field's interests, whatever they may be.

Analytic Objective 5: Determine what lessons can be learned from engaging the first four analytic objectives and apply those lessons to the field of rhetoric as a mode of critique about the pursuit of new neuro-informed rhetorical theory.

This analytic objective is the focus of discussion in the next Chapter. As a preview, the following chapter explores the role of field-familiar spokespersons, the role of support structures, the role of Nature, and the role of writing itself in constructing knowledge from the neurosciences in academic disciplines. Ultimately, the chapter asks what a neuroscience of rhetoric might learn and do in response to the exploration of translational processes that lead to dynamism in neuroscience findings.

CHAPTER 6:

NEUROSCIENCE OF RHETORIC: TRANSLATIONS AND RECOMMENDATIONS

Chapter One began with an overview of recent Humanities engagement with the neurosciences and explored the burgeoning subfield of Neurorhetoric. As part of that discussion, I presented and critiqued Diane Davis' animation of mirror neuron research as providing some material evidence for a Freudian form of affective identification that, in her view, exists always before Kenneth Burke's identification forged through discourse and is a more primary experience of identification. The critique was offered on three levels. First, I argued that Davis positioned mirror neuron research as evidence but drew upon a slim slice of that research, failing to recognize alternative views that had a bearing on ever turning to the neuroscience as useful to her claim. Second, I argued that she used the word "identification" in two different ways that are not at odds, even though she seems to use them that way—the first meant affective, pre-conscious unity with the Other, and the second meant discursive, conscious recognition of unity with the Other. It would be useful, I argued, to separate these two meanings out and not argue that one is more essential than the other since they are co-developmental; her use of the phrase "always already" in reference to a pre-conscious action likely should not assume "always already and unaffected" by consciousness. Third, and finally, I argued that affective identification, as presented in Davis' view, is only possible from two physical bodies that have experienced a dis-identification that can, in the first place, allow for a Freudian ego to emerge that can then experience identification; consequently, I found it unclear how her argument for the underlying unity of bodies could

be upheld as more significant and in contrast to Burke's argument from bodies physically divided. From those critiques, I also credited Davis' contribution to non-rational rhetorics and to material rhetorics while self-reflexively recognizing the force of her argument, its exigence in the field, and the inability of my own critique to resist her appeal for more attention to affect and the body.

The discussion from Chapter One is re-stated here to call attention to the rhetorical moves Davis makes when animating neuroscience and to see how the narrow choice of neuroscientific evidence and the multiple meanings ascribed to terms like "identification" result from a translational process wherein spokespersons, passage points, and support networks are needed to expand the field of Rhetoric. In other words, mentioning Davis' article is done to show how Rhetoric enters into a common process as other disciplines, a translational process designed to broaden the scope of the discipline by appealing the sciences, among other appeals, to further organize the material world into its own tradition, even when such scientific appeals are logically (although not tactically) unneeded, somewhat ancillary, or less than thorough.

Indeed, on the surface and at the outset, seeing what happens when disciplines draw on the neurosciences to do more work is exactly why this dissertation turns to the ANT framework of translation in the first place—it is a means of making claims about the rhetorical processes of disciplinary growth. Thus, one way of viewing what this dissertation has done can be summed up by saying it has translated ANT's notion of translation into a rhetorical framework fitting to and fitting within textual production. However, the textual analysis is not merely about tracing processes of discursive uptake and integration as fields

build knowledge; rather, it is more importantly about using textual analysis as one possible illuminating means to understand how material processes and practices in different disciplines re-assemble to make neurobiology "real" and "real" differently across domains while that neurobiology is performed—even in constructivist-oriented fields like Rhetoric—as stable and "real" in a way that must ignore or defy constructivist tendencies.

In other words, translation as a vehicle for rhetorical analysis shows how disciplines wanting to use the neurosciences treat neurobiology as locked in-correspondence under a philosophy of scientific realism;[28] mirror neurons evidence a theoretical point precisely because they are said to exist in stable, non-rhetorical correspondence with the "truth" of human materiality even while that supposedly non-rhetorical stability is dynamic, variable, often at odds, strange to the neuroscience literature, strange to the field, and made neatly compatible with personalities and theories spanning disciplines as different as Rhetoric is from Robotics. Translation as a textual-rhetorical exploration exposes the ontological multiplicity resulting from many realist claims of ontological singularity.

To the point: this final dissertation chapter concludes with a discussion of ontology, not epistemology. Translating a network-oriented ANT analysis into a textual analysis of translation is one way of pushing scholars from across the disciplines to reconsider the way they approach neurobiology with assumptions about its singularity and its unity—and more directly for the field of Rhetoric, the dissertation questions the commitments of rhetorical scholars seeking to expand the discipline through appeals to the neurosciences. In other words, making ANT's notion of translation into a rhetorical analysis of disciplinary

[28] For examples and discussion of scientific realism see: Hacking, 1983; Clarke, 2001.

expansion makes a broader claim about the making of multiple ontologies and suggests Rhetoric cannot advance rhetorical theory through anti-rhetorical gestures that resist the multiplicity of performed biology. This focus on making multiple ontologies in scientific practice—the perspective that specific texts, technologies, and practices used to make an object like mirror neurons come into appearance are constitutive of the object *as* object (Graham & Herndl, 2012)—is important insofar as cross-disciplinary work with the neurosciences must be re-situated as inherently rhetorical from the get-go.

Ultimately, then, the discussion of Diane Davis' invocation of mirror neurons—however ancillary or strategic referencing them might have been for her in the design of her own argument—brings to the fore a powerful and decisive link between what "works" rhetorically in a field as a result of its disciplinary politics and writing practices and what neurobiological entities, like mirror neurons, can be made into and how they come into appearance differently *because of* those rhetorical translation processes. In the end, then, calling attention to a translation dependent on what "works" in any discipline compels a consideration of what "price," as Latour (2005) says, these translations might end up paying for re-assembling their actor-networks in a way that works (p. 35).

Constructing a Neuroscience of X-Field: A Shared Architecture of Translation

Across all disciplines analyzed in this study, there are four general patterns comprising a shared translational process used to expand and re-assemble a discipline through an engagement with the neurosciences. The use of the term "pillars" is put forward

as a way to denote a more specific arrangement of actors and assumptions happening within Callon's four "moments" of translation; that is, although all disciplines perform moments of translation, there are ways of arranging actors and assumptions to perform those moments, which work like "pillars" for a new disciplinary structure. The first two pillars are ways that actors repeatedly move in relation to other actors. The remaining two pillars are assumptions adopted to strengthen the translation. Together, they collectively describe a common, although not necessarily universalizable, framework for how diverse disciplinary articles make neuroscience research "fit" into their fields. The discussion is not put forward as a recommendation for how to animate the neurosciences but as an observation and a critique that can lead to other recommendations later in this chapter having to do with attention to multiple ontologies resulting from cross-disciplinary exploration. In fact, the final section of this chapter considers the implications of these pillars and makes specific recommendations for doing a neuroscience of rhetoric under the banner of Neurorhetoric and under the assumption of multiple ontologies in scientific practice.

Pillar 1 – The Field-Familiar Spokesperson

The first discursive move required for the translation of neuroscience into a non-neuroscience field is to situate an actor in the moment of problematisation into the role of *the field-familiar spokesperson.* The problem for a field striving to animate neuroscientific work, in other words, must be to demonstrate relevancy and immediacy. This can be accomplished through a spokesperson familiar to the field. This actor can set-up the problem that the field

faces as one about the relevancy and immediacy of some otherwise strange neuroscience finding, exposing why that findings is central to the field.

In Davis' article, this familiar spokesperson manifests as Freud. As the central actor organizing mirror neurons, his idea about affective identification and, indeed, his whole system of thought, becomes the obligatory passage point for mirror neurons. Davis argues, for instance, that the Freudian Self is most essentially an identifying Self that functions affectively through mirror neurons. In this case, as it is in other articles across the disciplines, mirror neurons are shown to be relevant and immediate to the field by being placed into a logical identity with some pre-existing idea. A theory that is familiar and intriguing is given neuroscientific confirmation, revision, or elaboration to demonstrate the allure or the force of the neurosciences in the field. The existing actor-network that is Freud, to take him as an example, and the alliances maintained to his work in the field, allow the neuroscience research to move into the field *through* him.

Several Group Analysis articles construct a similar logical identity with a field-familiar spokesperson; they match neurobiology and field-specific theory, correlating mirror neurons with the developmental process hypothesized by actors familiar to them. In Group Analysis, for instance, that logical identity is made with Lacan, Pines, and Kohut and their discussion of human mirroring behaviors. Schermer (2010), to recall one example, discusses psychoanalytic theorists of the mirror and declares mirror neurons to be the "mirrors-in-the-brain" (p. 221). He does this as a way to concretize the logical identity between neuroscience research and mirror theory in psychoanalysis.

In brief, the first pillar of translation concerns who or what gives neurobiology a description of itself. The field-familiar spokesperson effectively problematizes the neuroscience as useful. Further, a logical identity between the material functioning of neurobiology and some familiar concept from some familiar figure integrates the neuroscience in the most thorough way.

Pillar 2 – The Spokesperson's Support

The second pillar frequently used to craft a successful translation of neuroscience is *the pillar of the spokesperson's support.* As might be expected, the actor doing the neurobiological interpreting for the field needs credibility (ethos) and good reasons for making that interpretation (logos). Showing neuroscience to be in agreement with a field-specific researcher familiar to the field bolsters the ethos of that actor to speak on a neuroscientific topic and makes neuroscience research a good reason to believe the claim. So pillar 1 is an explanation of what mirror neurons *are*, and pillar 2 is a neuroscientific agreement with that description. Strikingly, articles across all disciplines examined in this study position neuroscience research, at some point, as the second pillar.

The presentation of the neuroscience may come in the form of a quote from a neuroscientist who, for example, describes mirror neurons in terms of mirrors (Gallese et al., 2004) or in terms of a philosophical concept like Merleau-Ponty's hand-on-hand experience of Self (Rizzolatti & Singaglia, 2008), which seem to align with the field's existing conceptions of the brain or human development. These kinds of descriptions—and even the same descriptions—may be used in multiple disciplines to support any number of ideas.

Kalilia Homann (2010), for instance, asserts that "dance/movement therapists engage the brain through the body" and that the practice is "at the frontier of current trends in psychotherapy" (p. 80-81). To prove this, she uses the neurosciences. She first draws on several psychotherapists, including Porges and Shore, to establish Movement Therapy's impetus, and she then mixes their findings with cognitive neuroscientific sources and quotes, often employing secondary sources and mixing neuroscientific sources with theoretical ones from Movement Therapy as a way to show alignment and support (p. 82-84). Robotics enacts the same process. Tessitore et al. (2010) cite Rizzolatti—the same neuroscience researcher cited in Movement Therapy—to support a computational model that matches the efficiency of Nature, which becomes the field-familiar actor organizing the problem the field faces. From ANT's perspective, the field-familiar actor can be human or non-human; the point is that Robotics interprets mirror neurons in terms of its pre-existing view of efficiency and that neuroscience sources are "interessed" as support for the conception acceptable to the field.

As Philosopher García-Carpentero (1994) notes, source incorporation is done for particular reasons, and the quotation is a sign producing stability for the text. He states, "quotation marks are the true referring expression in quotations; the word inside them is not really a word but a thing, a token, and is there to help fix the content" (p. 253). In other words, quotations become anchors with roles—to describe objects or situations, to illustrate an idea and provide an example, to support a claim through showing others in agreement, or to fill several of those roles at the same time. That the neuroscience research is used as support, showing scientists in agreement with field-familiar spokespersons, is an interesting feature of cross-disciplinary animations. The neuroscience cannot be brought into the field

fresh and radical in the translational process because the translation would have no perceptible commentary to offer, no bridge to existing discourses. Thus, even in cases when articles reject a neuroscientific interpretation, like those in Robotics, alternate neuroscience sources and possibilities can be used as support for a more favorable interpretation that is more favorable because it resonates with the argument and with the field's history that enables that argument.

In short, the neuroscience is regularly subordinated to the field, presented as in alignment with established theorists or interests. So despite the fact that the neuroscience is said to be doing the new, exciting work for a field of study, the translation process suggests that the neuroscience is really marginalized to do the work that the field can do. The neuroscience does not appear in a non-neuroscience field in a flash with radical changes; field-specific actors adapt it to the field, and the neuroscience then supports it.

This is not to suggest that the articles in this study do not use neuroscience sources or quotations to describe mirror neurons and detail their biological functioning. Instead, this is to suggest that when articles engage in that kind of explanatory, descriptive activity, they do so as a means of demonstrating support for a special or particular interpretation of mirror neurons that pre-exists the quote in the translational structure. In other words, descriptions of neurobiological materiality anchor interpretations of functioning that already resonate with some concept or term from the field's history; that is why the neurobiology is mentioned in this distant disciplinary context in the first place.

This process is well documented in Chapter 4. For example, the Movement Therapy sample contains several articles that present mirror neurons as biological mirrors moving

together within and between two bodies just as the outside physical bodies move together in front of literal mirrors. The fact that much neuroscience research suggests that mirror neurons may not be mirrors at all or may not "mirror" every action is discarded or overlooked; articles supporting this view of mirror neurons as like mirrors are, instead, the focus of attention. Articles in Phenomenology, as another example, evaluate mirror neuron interpretations as antagonistic to the field, and as a result, they demonstrate the wrong interpretation through neuroscience quotations, re-asserting their own correct interpretations by privileging their own history of phenomenological thought. The same general process happens in Davis' article when she uses neuroscience as evidence for Freud. The neuroscience is subordinate and put into a supporting role.

Pillar 3 - Nature

The third pillar is *the pillar of Nature.* This pillar stands as an assumption about scientific work and the accessibility of Nature. It is a way of enrolling Nature to speak on one's behalf. If the assumption that Nature is on "our side" is maintained, then this becomes visible in an appeal to Nature as part of the new actor-network. The pillar of Nature acts as support for neuroscience sources through claims of a logical identity between "Nature" and whatever those neuroscience sources evidence. Nature, in other words, supports the neuroscience, and the neuroscience supports the field-familiar spokesperson.

Nature solidifies the actor-network through establishing a rhetorical alliance that is difficult for non-scientists from the Humanities or Social Sciences to call into question. If neurobiological materiality and "Nature," in all its persuasive glory, are presented as being in

logical identity, then questioning the alliance requires challenging Nature. Since Nature is tied to neurobiology, this task falls outside the purview of the Humanist or the Social Scientist; the actor-network remains protected by being tucked into the domain of the neuroscientist.

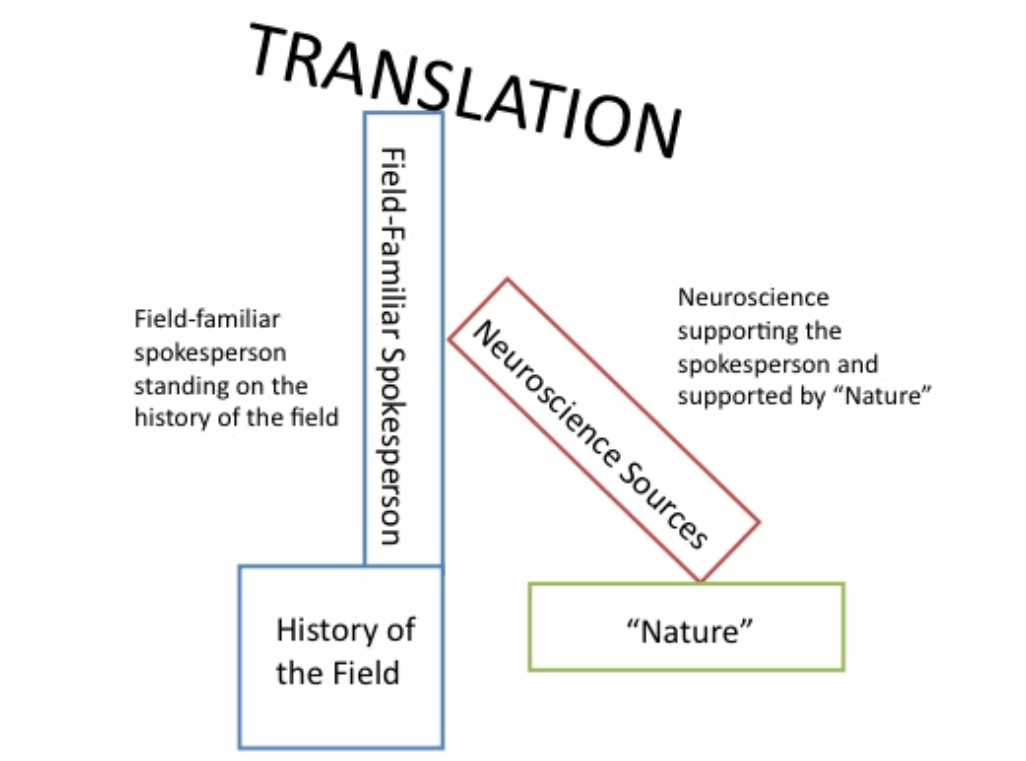

Figure 6-1. Translating Neuroscience into a Non-Neuroscience Field – Pillars of Support

Echoes of this general translational structure can be seen even in Davis' article. For example, she argues that the materiality of mirror neurons *is* Nature when she argues that Freud describes what identification *is* and that mirror neurons *prove* it. Thus, there is an implied claim: the neuroscience finding is not a representation of Nature but Nature itself. This is simply another viable way—one way among many—through which Davis is able to

make an argument that Freud's conception should overturn Burke's conception. As a result, arguing with Freud becomes even more difficult with this additional pillar than arguing with Freud would already otherwise be.

As discussed in Chapter 4, this is a rhetorical move all too common to Science and Technology scholars. Bruno Latour (1987), for one, recognizes that "once the controversy is settled, it is Nature the final ally that has settled it" (p. 97); of course, as Latour points out, Nature speaks fluently on all sides during any scientific controversy, and Nature is made to speak in accordance with the tools, practices, and discourses of those speaking. In the end, "Nature" never settles anything yet always seems to settle everything. Nature is a powerful ally and a good way to solidify a new actor-network. It can be used as an actor in a moment of enrolment when the roles for actors are interrelated to resolve the problem the field faces, and/or it can be used in a moment of mobilization to ensure that other actors cannot be betrayed by alternate conceptions (Callon, 1986, p. 196).

Pillar 4 – Objective Writing Practice

The fourth and final pillar required for a successful translation of neuroscience research into another field is *the pillar of objective writing practice.* This pillar manifests as a continuation of representational practice in Western societies wherein the inscription or the mark represents objective, ideal forms. Much scholarly work has been completed on this topic, including Miller's discussion of the "window pane theory of language" (1979), Lakoff and Johnson's (1980) "conduit metaphor" of language, and Lanham's (1995) discussion of the "transparency thesis." Each of these Humanities scholars would agree with Lanham's

assertion that there is no "truly transparent language" because there is no neutrality or non-rhetoricity to language (169). Nevertheless, writing, like language tout court, is still commonly treated as pointing to an objective outside, and the good professional and technical writer is supposed to make writing transparent, un-rhetorical, a window; this is, as Miller (1979) recognizes, the history scientific writing (p. 612). And that history flows into disciplinary animations of mirror neuron research as those animations continue to point seemingly unaffected by the pointing.

This is not necessarily surprising, as Lawrence Prelli explains, because rhetoric is thought to be "stylizing… junk food for the mind" while "Science, on the other hand, is thought by many to be the pinnacle of human achievement. Conceptualized as a body of stable, certifiably 'objective facts' interrelated validly by rigorous logic, science is seen as promising progress in knowledge" (p. 1). However, as Prelli points out, this is the continuation of a long myth; scientists also "make a special kind of *rhetoric*" and "*invent* scientific discourse" (p. 1, italics in original). Of course, as Katherine Hayles (2005) notes, the belief that Science transcends the creative powers of discourse is in tune with the Western history of metaphysics that expresses a deep "yearning for presence," which even today, resists being resisted (p. 17). Yet, despite the position of Science as carrying the banner of objectivity, one might assume that rhetorical scholars' writing about a scientific materiality that writes the social and interpersonal body would be characteristically rhetorical and anti-objectivist. This, however, might not always be the case. The brain may well be too seductive (Weisberg, 2008) to be treated rhetorically, at least in any explicit manner.

All of the disciplinary animations of neuroscience explored in this project assume the transparency thesis of writing in the appeal to Nature and the dismissal of the creative powers of words, phrases, metaphors, and argumentative frames. When Robotics articles, for instance, speak through the language of systems and data, their authors do not self-reflexively declare the way those terms, as Anne Bealieu (2005) suggests, make facts though identifying with the epistemological privilege of mathematics. Likewise, the articles do not recognize, as Kelly Joyce (2002) says, that discussions of data makes "human actions and values… disappear" (p. 438). Similarly, when Movement Therapy articles shift to the interpersonal "we" voice, there is no discussion of how it interpellates the audience, compels agreement, and enacts Callon's moment of mobilisation. Writing, like the world in the Western philosophical conception, still apparently exists "independent of the specific properties of human minds" (Lakoff and Johnson, 1999, p. 21).

In the contemporary rhetorical tradition, the "rhetoric is epistemic" argument stands opposed to the transparency thesis and suggests that language use is a way of knowing and is, thus, intimately constitutive of knowledge forms (McKeon, 1994; Scott, 1967). This is an argument that follows in the post-structuralist trajectory of the 1970 and 1980s and can be understood as a response to what Derrida (1978) calls the "the anxiety of language" after structuralism (p. 3). That is, the rhetoric is epistemic argument is a constructionist position raised after the structuralist pursuit of objective order, truth, and beauty in texts, which ultimately produced an "anxiety" about the failure of that project. It is worth briefly rehearsing the response to structuralism here if only to assert that Science continues to align

with the aims of structuralism and be performed independent of post-structuralist insights but may not be able to sustain this independence much longer in a materialist world.

Regarding structuralism, it is Derrida's view that the imperfect object of writing could not produce the perfected object that a Modernist structuralist standpoint desired in its dedication to reduce fascination, affect, and possibility to a literary and linguistic structure. Indeed, Derrida declares that structuralism deserves investigation "by virtue of an irreducible region of irreflection and spontaneity within it, by virtue of the essential shadow of the undeclared" (p. 4). In simpler terms, Derrida argues that language retains an "irreflection," a possibility of the negative and the invisible, a possibility that it writes out as it writes whatever is visibly taken into account by scholars organizing, measuring, or interpreting it. Language has a spontaneous shadow of meaning. The structure of language, "formerly attributed to instinct, which was said to be certain as it was blind" was conceptualized as "the formal unity of form and meaning" (p. 5). But as Derrida points out, the accounting of this formal unity, seeking after totality, is "like the architecture of an uninhabited or deserted city… in a state of being haunted" (p. 5). In short, the "anxiety of language" results from encountering Derrida's view that language cannot transfer Knowledge "uncorrupted" and un-endowed with multiple meanings, shades, and shadows.

But after post-structuralism, the locus of instability and change is not only on symbols; it is more broadly material, ecological, a combination of words, bodies, practices, habits, instruments, institutions. So although Science seeks after totality and engages in an essentially structuralist practice of seeking the irreducible and organizing material worlds by objective universal laws, the incorporation of the material into a revised post-structuralist

trajectory that now keeps material forms as intimate to both knowledge creation and to the formation of objects themselves may have the potential to undo the dominance of big-S Science. This is the case because material processes and practices are organized into the realm of world-making. Language and writing are no longer deemed solely responsible for this task.

Thus, it would stand as somewhat of a surprise to see scholars, especially rhetorical scholars invested in materiality, recognizing writing as a change-agent while claiming, nevertheless, to inscribe the "real" world of the brain over and onto rhetorical theory. Across the disciplines, the brain appears as the new ideal form. The ideal of the ancient world, located above in the invisible of the heavens, has been replaced, not eradicated. The history of Western metaphysics can help explain the difficulty in thinking about neurobiological materiality as performative and as having multiple ontologies that are partially formed through writing practice. However, there is little doubt that the brain, visualized by scanners, explored through institutional practices, described in metaphors, unlike a mirror, cannot continue to be treated as a reflection of the real.

The Predicament of Writing Today Performed Across the Disciplines

The discussion above suggests that the Humanities and Social Sciences face a predicament today when discussing the role of writing. Is it to be treated as an unproblematic mode of transference or as wholly constructive on its own? To do the latter would be the ultimate denial of the Western tradition, and one that Derrida, as a theorist, seems to champion best (See: *Writing and Difference*). However, taking the Derridean route would be

to continue to ignore materiality, and this is exactly what rhetorical scholars are trying not to do right now. The other route, however, is no longer tenable. In short, it seems the academy still struggles with deciding when to call any writing about the human body a reflection of the "real" and when to give the power of creation over to a body of writing. This is the dichotomous predicament of writing that must, ultimately, be overcome or undone.

The Predicament of Rhetoric

To some extent, the contemporary field of Rhetoric has been given the job of calling attention to the creative powers of spoken and written language, or has taken that job upon itself. Whatever the case, this is no guarantee that rhetorical scholars, when engaging the neurosciences will, like scholars from other fields, resist the draw to desperately argue for *the* true mirror neurons and situate the entire conversation around what the neurosciences *really* say and how humans are *really* persuaded. But this orientation to the neurosciences results from a the long history of the West as well as from the more recent history of the priority of the brain, the dominance of the neuroscientific way of knowing, and the recognition of the importance of materiality and the "reality" of the material world that must be heeded by humans and nonhumans alike. Ceasing "the demonization of scientific materiality," as John Lynch suggests, and moving beyond a logic of representation, does not necessarily mean performing scientific materiality in Rhetoric a-rhetorically. For Lynch, the way forward is making materiality into an "articulation" that is also rhetorical. The approach has it uses but may be limited from the standpoint of multiple ontologies.

In attempting to transcend a materiality-discourse dichotomy in the Rhetoric of Science, Lynch rejects a correspondence theory of truth by focusing on what scientists do. He breaks scientific materiality down into three overlapping “registers” that he calls the material, the social, and the rhetorical, showing how what scientists do foreground one or another register. In this way, he argues that a sign-object correspondence was a fiction from the start. He, rather, makes the sign an overlapping blend of these three registers and one that changes with the articulation. The sign, in short, becomes “real”—and “real” differently over time—because of the practice of scientific researchers in making it simultaneously a material, social, and rhetorical force. In this way, Lynch tries to transcend a metaphysics of the singular “real" tied to writing about the material world. That is, he views words about materiality as a rhetorical assemblage made from scientific practice. However, in emphasizing an analysis of the sign as a blend of registers made in scientific practice, he seems to assume rhetorical scholars should heed the materiality of the sciences as “real” in the way the scientists assemble them as “real” in their languaging of them. The practice of rhetorical scholars in making their own ontologies of the material world from the work of the sciences—making mirror neurons, for example, into X, Y, or Z that “fit” into rhetorical scholarship—is not addressed.

The following section of this chapter argues that attention to translation, as a rhetorical process, negotiates the long-standing dichotomy between a traditional Western correspondence theory of truth based in “real” representation of the outside world and a postmodern, constructivist one based in discourse. It does this by suggesting that rhetorical scholars can 1) explore the numerous possibilities presented by the neurosciences and

construct their own ontology of mirror neurons as a result of 2) adopting their own knowledge-making as a coherence-making process that must work, at least in part, through writing and negotiate translation in a way that remains acceptable to their field. This is different than John Lynch's recommendation from "articulation" insofar as it does not assume rhetorical scholars can or should necessarily explore or heed the "reality" made by the sciences before or even while doing a neuroscience of rhetoric.

In other words, the approach here assumes that rhetorical scholars will, almost intrinsically, cease to accept scientific research if they can easily expose its rhetorical flaws or ill dependency on social categories. Consequently, the "neuroscience of rhetoric" in this conception needs to most primarily focus on the coherence-making practices of rhetorical scholars when encountering research that seems easy for the uptake. This is, afterall, the research that is pulled into doing a neuroscience of rhetoric—the research that has potent and exciting connections. Ultimately, the chapter challenges rhetorical scholars to adopt multiple ontologies. That means embracing what Scott Graham and Carl George Herndl (2012) call a "post-plural theory" which suggests that "the reality you engage is determined by the kinds of actions you habitually perform and the material contexts in which you act" (p. 11). Doing this, pragmatically, requires considering the trajectory of one's own field, knowing its history, expectations, and methodological requirements, and practices, while exposing the neuroscientific range of interpretations from which one is more attractive or potent as a field-specific reality from the perspective of the researcher doing the translating; it requires seeing the text in the way ANT scholars see the text—as the praxiological made alive and open to analysis in that textual form, a movement of actors in a field acting from and within the

constraints of their field *through* the text to translate the neuroscience. And it then requires choosing a translation as an invention that does not stand as *the* singular solution but as good work in the field, all while harboring a keen awareness of the potential pitfalls and possibilities of taking sides in controversies embedded in neuroscientific research.

Pursuing a Neuroscience of Rhetoric

Recommendation #1: Make Field-Specific Connections Explicit

A neuroscience of X-field follows its own intrigue. This is largely what I have shown. Thus, analyzing why a field, like Rhetoric or Group Analysis or Robotics, draws on the neurosciences in the first place is a key step toward thinking about the ontologies constructed and what is at stake. Thus, my first recommendation for pursuing a neuroscience of rhetoric is for rhetorical scholars to articulate the connections they see between the two fields. Making them conscious and explicit can highlight some of the hidden forces of translational decisions and open up other possibilities.

A few rhetorical scholars have already attempted to express why they might be interested in the neurosciences. For instance, Mays and Jung (2011) point to a direct link between the rhetorical scholar's orientation toward language and the work of neurobiology. They state, "if language is neural, then anyone dealing with language is in fact dealing with neurological processes. It is to be expected, then, that research into these processes would make their way into our Discipline" (p. 46). Here, Mays and Jung draw on George Lakoff and Mark Johnson's (1980) discussion of language as "a matter of neural connections—

connections between speech sounds, writing, or signs" (p. 232) in order to suggest that neurobiology gives Humanists "hard" science proof of language as a postmodern scaffold of relations. The point of connection, then, is that both fields are invested in a deontological philosophical view that sees mind arising from nothing but material brains. This need to evidence a view of language indicates an interest in scientific evidence, in materiality, and, perhaps, an interest in finding ways to talk across disciplines and persuade other disciplines of this view. The need for scientific "hard" evidence is a recurring theme across disciplines turning to the neurosciences, yet the affinity for engaging the neurosciences in Rhetoric may also be due to just how well rhetorical scholarship is geared to an analysis of the work of the brain sciences.

If the work of the neurosciences is itself relational—a job of correlating brain systems with functions—then the brain is a material metaphor, and the analysis of the social contingencies of metaphor is central to the work of rhetorical scholars. Neurobiology engages in the work of representation, and the neuroscientific image, insofar as that *is* for all extensive purposes the brain, contributes to making a reality of brains and, accordingly, people; in short, imaging systems write the brain and engage in a rhetorical process subject to rhetorical investigation. As Joseph Dumit (1999), Anne Bealieu (2002), and Lisa Cartwright (1995) have well noted, brain imagery is interpreted through a reading process specific to neuroscientific expertise. As a result, the brain tells a story, and rhetorical scholars find opportunity to examine the work.

In addition, the choice to animate neuroscientific work in Rhetoric seems embedded in a propensity to pursue a historical moment in the field of Rhetoric where materiality needs

to be taken into account in new and dramatic ways after a long postmodern abyss of relativism blamed on the self-internalizing constructive powers of language. Viewed this way—as a historical moment that the field encounters—a "neuroscience of rhetoric" engages neuroscientific materiality as a politics. The politics is institutional and philosophical, meaning the choice to animate neuroscience research is made, first, to bolster rhetoric through a new alignment with the sciences and through a renewed rejection of the dogmatic relativism of postmodernism that has been sufficiently dispelled in many segments of the university. This first alignment confirms the work of the Humanities as valuable and pragmatic, like the Sciences, in a period of renewed "wars" over university funding and purpose (Collini, 2012; Nussbaum, 2010). So a neuroscience of rhetoric is political in that institutional sense. But, second, it is also political because the alignment with the sciences contributes to a broader philosophical battle against the One of liberal humanism, as outlined in Chapter One and as explored in the discussion of Diane Davis' reasons for drawing on mirror neurons as proof that humans are not entirely rational, divided, and dependent on discourse. Showing humans are united, similar, and affective by nature (Davis, 2010) engages a battle that seems especially important in an age of increasing global relations and unwieldy economic and technological dependencies. So, in short, there is a dual-politics to doing a neuroscience of rhetoric—institutional and philosophical. These politics stir beneath animations of neuroscience research.

As a result, translations of neuroscience move in specific directions. Movement Therapy, for example, expresses anxiety about the field's legitimization due to a dedication to therapist's subjective narratives and, thus, articles from that field pounce on a specific kind

of translation of mirror neurons that seem to validate the field institutionally (See: Meekums, 2010). Another way of saying this is that ontologies of mirror neurons have a correspondence to what works in a field at a point in time when that field negotiates its own institutional and philosophical politics. Thus, highlighting perceived connections between fields uncovers some of the hidden forces that contribute to the enactment of translational moments.

Recommendation #2: Make a Neuroscience of Rhetoric Multiple

Multiple ontologies of mirror neurons that are constructed from field-specific actors and influenced by a field's politics can trouble the two most prominent solutions to using neuroscience research to challenge or question traditional ideas in Rhetoric.

The first solution is offered by Jordynn Jack and Gregory Appelbaum (2010). They argue that rhetorical scholars must move back and forth between a "rhetorical lens" and a "neuroscientific lens," learning the neuroscience, understanding the neuroscientific perspective, and then evaluating the work by thinking about rhetorical concerns, working critically, forging partnerships when needed (p. 414). The second solution is offered by Chris Mays and Julie Jung. They argue,

> it is not only possible, but also necessary and productive, for scholars in our discipline to 'figure out' the knowledge provided by brain science prior to importing it. There is no need to enroll in scientific doctoral programs, of course, but there is also no need to refrain from problematizing research that purports to be authoritative. By working with what we *can* figure out—that is, by emphasizing the rhetoricity of these

> scientific arguments *as we import them*—we combat their tendency to overwhelm and, by troubling default, resume their status as foundational knowledge. (p. 47)

The problem with May and Jung's view is that it assumes there is a right or correct and stable "knowledge" offered by the neurosciences. This is tantamount to the third pillar—the appeal to Nature. "Figuring out" the neuroscience, they suggest, enables rhetorical scholars to then import it. Without recognition of a translation process, whatever is "figured out" risks embarrassing the researcher and returning to the drawing board once the claim that he/she has "figured it out" is again called into question and put at odds against the new version of Nature. Put differently, Latour (2005) argues in *Reassembling the Social* that every translation "pays the price" for how it has arranged its actor-network (p. 35). Group Analysis, for instance, may well "pay the price" for narrowly translating mirror neurons as direct embodied "mirrors-in-the-brain." Likewise, rhetoric articles asserting mirror neurons confirm old theories and theorists without recognizing alternate interpretations and arranging for the possibility of upheaval may "pay the price."

Although Jack and Applebaum offer a reasonable but general way forward in conducting a neuroscience of rhetoric, their suggestion, too, has not quite come to terms with the force with which field-specific actors and disciplinary history and writing practices alter neuroscience-made-active in a field. To do so would recognize how a rhetorical lens infiltrates a neuroscientific one at every moment. More specific recommendations, however, can better account for the translational process.

Most basically, re-positioning the goal of a Neurorhetoric away from using *the* (singular) neuroscience finding as a way to construct new knowledge about the (singular)

human subject and toward the invention of active structures that are pragmatic, inventional, and subject to multiplicity at every level would be a first step. In other words, seeing the robots of Robotics as "working" even though the neuroscientific interpretation might be at odds with much of the neuroscience in the neurosciences takes as primary the activity of the translation and measures it against the possible neuroscientific interpretations of the translation. This is a process that sees what can be done and thinks about the cost of doing it. Indeed, seeing new neuroscientific descriptions of the human brain as "working" from a specific translation of neuroscientific work can be the goal of a pragmatic Neurorhetoric if it is pursued in awareness of the potential multiplicity offered by the neurosciences. Thus, I am implying a two-step process that entails 1) recognizing the translation as one of many possible translations, which is chosen because it does valuable work for the field, and 2) questioning the long-term viability of the translation as a working and workable one.

This is where revisiting Davis' revision of Burkean identification proves especially interesting and one of the major reasons for bringing it up again in this chapter. That is, despite all of the critiques discussed about her article, she effectively "works" in her field. In other words, she effectively responds to the politics of her field. She uses Freud and mirror neurons to tell a story about our entwined ecological condition; she helps rhetorical scholars to do the ethical and political work of embracing non-rational rhetorics and materiality as they strive to disentangle from the logocentrism associated with Western humanism and "print culture." She takes advantage of a popular move toward "affect" to do this work, and she convinces, it seems, rhetorical scholars to think about the non-symbolic, non-conscious processes of the human by drawing on a long and highly publicized and quite impressive

decade of cognitive science research pointing to non-conscious influences in everyday life. Works like by Damasio (1999), Robinson (2005), and Appiah (2009) are her context and her sub-text for quoting Edbauer-Rice (2004), Shaviro (1990), and Mucklebauer (2007), not to mention mirror neuron researcher Rizzolatti (2002). In brief, the ontology of mirror neurons that she constructs "works" for her field. This is precisely what a neuroscience of rhetoric should do.

From an ANT perspective, however, the success of her translation must be measured against other possible network assemblies. Indeed, the way to ensure a new actor-network is to strengthen it against being un-done in the future. Thus, the better way to "work," as my critique of Davis' article in Chapter One argues through demonstration, is to account for the multiplicity and possibility offered by the neurosciences and to call attention to the selections and deflections made in the process of translating the neuroscience. Doing this, at the outset, might seem anti-rhetorical insofar as it highlights the attempt to persuade, which is usually hidden and accomplished through an "art of concealment" (Miller, 2007). However, because Rhetoric of Science scholars and Science and Technology Studies scholars have repeatedly pointed out the way scientific findings can always be called into question and are subject to social fluctuations (Collins & Pinch, 1993; Prelli, 1989), treating them as stable or as objective findings simply seems staged and untenable. That approach exposes the hand of the rhetor in the context of Rhetorical Studies and risks the integrity of the persuasive means. Further, because cognitive neuroscience research is particularly complex and at a fairly nascent stage, brain findings are today, as cognitive neuroscientist Robert Hecht-Neilson (2003) says, "like a huge collection of small, jagged, jigsaw puzzle pieces piled around in a

large warehouse" and "few attempts to find pieces in the mound that fit together have succeeded" because neuroscientists are "still missing pieces" (p. v-vi). Thus, taking each finding with a grain of salt displays prudence and awareness of the brain sciences in the same way that detailing all the various positions on mirror neurons displays competence and lends ethos. In addition, pointing out multiple possibilities opens the field of play for scholars and ceases a terrorization of the brain on categories of the human.

Recommendation #3: Pay the Price Up-Front and Rebuild the Pillars of Translation

Whatever a neurobiological finding is said to mean for Rhetoric, the interpretation must be prepped for revision. This is because one neuroscience finding is tested and re-tested, compared to those other studies, and subject to competing frameworks of interpretation, even within the neurosciences. As Rizzolatti and Singaglia (2008) explain, until recently, the motor system of the brain was viewed as serial and isolated, but a new perspective, partially invigorated by mirror neuron findings, suggested otherwise (p. 2); in other words, perspectives of the brain change over time, and interpretations are subject to a whole network of beliefs about the brain. For example, for F5 motor mirror neurons to even be interpreted as "mirror" neurons, a researcher must arrange the experiment and then choose to analyze the resulting fMRI image from a position that assumes functional specificity and ignores the possibility that one neuron can be engaged in multiple cognitive processes (Turella, 2009, p. 18). To not assume this would be to open up the possibility that a neuron is not "mirroring" at all when firing like a mirror neuron is supposed to fire but, rather, serving different roles in complex pathways of performance.

In short, to argue for singular interpretations risks paying a high price when the cost of a translation that works well in a field can be lowered through recognizing neuroscientific processes and competing possibilities at the start. To some extent, this is what Jack and Appelbaum (2010) imply when they argue for moving back and forth between a neuroscientific lens and a rhetorical lens, but the way to do that "moving" can be more explicit and thorough. For one, a rhetorical scholar taking a stand on a neurobiological finding, for whatever reason, can acknowledge the dependence on scientific agreement and the possibility of competing interpretations overturning the finding or doing better pragmatic work in the field. They can, in short, pay a lower price up front, instead of a higher one later.

In fact, the pillars of translation as outlined in this chapter can be collapsed and then re-arranged to make the neuroscience of rhetoric explicitly rhetorical while showing respect for neuroscientific ways of knowing and for a materiality that needs to be heeded. Most significantly, switching the first two pillars can center the neurosciences as multiple even as it recognizes Neurorhetoric as acting rhetorically.

The first pillar of translation depends upon a field-familiar spokesperson and allows the neuroscience finding to move into the field without much resistance. However, in many cases, it seems reasonable to believe that the neuroscience finding could be adopted even if it is explored in detail and from a position of controversy prior to choosing an interpretation from a field-specific spokesperson. Spending more time on neuroscience studies and processes would, effectively, compel the rhetorical scholar to sort through the possibilities, respecting the neuroscientific conversation by not subordinating it to the immediate re-organization of the field. The neuroscience research, as a body of work, could be given

priority in translation and made into the first pillar. At that point, the choice in assessing what can be done with it would be exposed as rhetorical.

Calling attention to other possibilities while recognizing the one most pertinent to the field does not erase the possibility that *is*, in fact, pertinent to the field. And neither does it erase the field-familiar spokesperson who helps to move it into the field. To some extent, Papoulias and Callard (2010) are being confirmed by this recommendation insofar as they argue that Humanities scholars need to read more neuroscience and do a better job of discussing it. However, recognizing the translation process as constrained by the field's history, actors, and politics does not privilege the neuroscience in the same way that Papoulias and Callard seem to do. Instead, highlighting the neuroscience's own multiple spokespersons privileges the rhetorical scholar as a rhetorician who makes a choice in an attempt to do something new and push the field into exciting territories from that multifaceted neuroscience discussion. The shift, in other words, is to a pragmatic and self-reflective rhetorical interpretation that is constrained by a material-symbolic assembly under the assumption of multiple ontologies made across researchers and fields.

When a neuroscience of rhetoric is conducted in this way, Nature is never on one's side, and that is just fine. The need for Nature disappears when neuroscience findings are made multiple through a field's history and practices. What a field does—how its actors move and how its writing performs those movements—gives the foundation that Nature previously provided. Indeed, just as Nature was not reliable because it spoke fluently on all sides of a controversy, so do fields coming from different backgrounds and perspectives

speak fluently on all sides of neurobiology. Thus, there is no loss in the disappearance of Nature except the loss of a higher price to pay for claiming it.

Conclusion

Ultimately, the recommendation here is to re-think a Neurorhetoric that operates from an investment in *the* human as an object of inquiry about *the* workings of persuasion. Put differently, if Neurorhetoric is pursued for its ability to evidence rhetorical theory or revise rhetoric through new material descriptions—and those are treated as the most "real" and "objective" of descriptions—then this necessitates adopting a terminal view of the human and requires forging logical identities with specific neuroscience findings. But finding another mode of thinking about the human and the neuroscience, staged in multiplicity, offers another possibility. Another mental architecture for Neurorhetoric is the unending action of translation, multiplicity. Thinking from translation de-centers the goal of finding more accurate descriptions of the human and human persuasion. Instead, it makes Neurorhetoric explicitly contingent, multiple, pragmatic, and political.

A neuroscience of rhetoric could learn from Davis' (2010) drive to expand the perspective of the human as always "exposed" or, rather, always coming into appearance through thresholds made possible from what we call the outside (p. 8-9). That is, a rhetoric of the many and not of the few, one that exposes the way it forms itself in making choices to select and deflect, one that stands open to a complete, even totalizing revision, will not only be the most rhetorical, but the most persuasive in the long term. The move to see scientific work as an equally legitimate form of knowledge-making does not require tip-toeing stealthily between a constructivist epistemology and a logical positivist one; bridging an

epistemological gap does not require deference to the sciences or a rejection of rhetoric. In fact, if rhetorical theory is to fold in work from the sciences, then it must simply expose the choices it makes in choosing the neurosciences as a viable avenue of knowledge-making and theorizing and expose how a new rhetorical insight comes into appearance against other possibilities. This means forgetting about epistemology as an order or as a priority and, instead, being open to either source undoing whatever a scholar on either side seeks to do with a reigning mantra of exposure of knowledge's exposedness. This means embracing translation processes and the "realities" of multiple ontologies.

If a turn to the neurosciences in rhetoric is pursued, at least partially, for its ability to uproot liberal humanism's emphasis on a human life free and independent of the surrounding environment, then to make the same mistake in our rhetorical theorizing—to treat the neurosciences as now offering golden nuggets of observational Truth that remain free and independent of the surrounding environment that animates them is also a mistake; yet, to think that rhetoric cannot partner with this other way of proceeding seems like a mistake as well. So if rhetoric may partner with the neurosciences and may legitimately be said to advance the field as a result, then it will only do so insofar as what the neurosciences offer is made coherent within a rhetorical logic through a process of coherence-making in an environment full of competing institutional and philosophical interests that can be and should be exposed.

REFERENCES

Adolphs, R., Tranel, D., & Damasio, A. (1998). The human amygdala in social judgment. *Nature*, *393*, 470-474.

Amossy, R. (2002). Introduction to the study of doxa. *Poetics Today*, *23*(3), 369-394.

Appiah, A. (2008). *Experiments in ethics*. Cambridge, MA: Harvard University Press.

Ballif, M. (1998). Writing the third- sophistic cyborg: Periphrasis on an [in]tense rhetoric. *Rhetoric Society Quarterly*, *28*(4), 51-72.

Baron-Cohen, S. (2005). Sex differences in the brain: Implications for explaining Autism. *Science*, *310*(5749), 819-823.

Bazerman, C. (1988). *Shaping written knowledge: The genre and activity of the experimental article in science*. Madison, WI: University of Wisconsin Press.

Beaulieu, A. (2002). Images are not the (only) truth: Brain mapping, visual knowledge, and iconoclasm. *Science, Technology & Human Values*, *27*(1), 53-86.

Bender, J. B., & Wellbery, D. E. (1990). *The ends of rhetoric: History, theory, practice*. Stanford, CA: Stanford University Press.

Besel, R. (2011). Opening the "black box" of climate change science: Actor-Network Theory and rhetorical practice of scientific controversy. *Southern Communication Journal*, *76*(2), 120-136.

Bitzer, L. (1968). The rhetorical situation. *Philosophy & Rhetoric*, *1*(1), 1-14.

Blair, C., & Michel, N. (2007). The AIDS Memorial Quilt and the contemporary culture of public commemoration. *Rhetoric & Public Affairs*, *10*(4), 595-626.

Blakeslee, S. (2006, January 10). Cells that read minds. *The New York Times*.

Bolduc, M. K., & Frank, D. A. (2010). Chaïm Perelman and Lucie Olbrechts-Tyteca's "On Temporality as a Characteristic of Argumentation": Commentary and Translation. *Philosophy & Rhetoric*, *43*(4), 308-335.

Brady, A. (2004). Rhetorical research: Toward a user-centered approach. *Rhetoric Review*, *23*(1), 57-74.

Brown, B. (2010, November 20). Methods used to study the brain. *Georgia Perimeter College*. Retrieved from http://facstaff.gpc.edu/~bbrown/psyc1501/brain/methods.htm

Buccino, G., Binkofski, F., & Riggio, L. (2004). The mirror neuron system and action recognition. *Brain and Language*, *89*(2), 370-376.

Buccino, G., Binkofski, F., Fink, G., Fadiga, L., Fogassi, L., Gallese, V., ... Feund, H. (2001). Action observation activates Premotor and Parietal areas in a somatotopic manner: An fMRI study. *European Journal of Neuroscience*, *13*, 400-404.

Burke, K. (1950). *A rhetoric of motives*. New York, NY: Prentice-Hall.

Burke, K. (1966). *Language as symbolic action: Essays on life, literature, and method*. Berkeley, CA: University of California Press.

Buscarino, A., Camerano, C., Fortuna, L., & Frasca, M. (2010). Chaotic mimic robots. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *368*(1918), 2179-2187.

Callon, M. (1986). Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St Brieuc Bay. In *Power, action and belief: A new*

sociology of knowledge? (pp. 196-223). London: Routledge.

Callon, M. (1999). Actor-Network Theory: The market test. In J. Law & J. Hassard (Eds.), *Actor Network and After* (pp. 181-195). Oxford: Blackwell.

Callon, M., & Law, J. (1997). After the individual in society: Lessons in collectivity from Science, Technology and Society. *Canadian Journal of Sociology*, *22*(2).

Cartwright, L. (1995). *Screening the body: Tracing medicine's visual culture*. Minneapolis, MN: University of Minnesota Press.

Ceccarelli, L. (2001a). Rhetorical criticism and the rhetoric of science. *Western Journal of Communication*, *65*(3), 314-329.

Ceccarelli, L. (2001b). *Shaping science with rhetoric: The cases of Dobzhansky, Schrödinger, and Wilson*. Chicago, IL: University of Chicago Press.

Cheng, Y., Chou, K., Decety, J., Chen, I., Hung, D., Tzeng, O., & Lin, C. (2009). Sex differences in the neuroanatomy of human mirror-neuron system: A voxel-based morphometric investigation. *Neuroscience*, *158*(2), 713-720.

Cisbra, G. (2005). Mirror neurons and action observation. Is simulation involved? *Interdisciplines*, *Jan.*, 1-5.

Clark, A. (2003). *Natural-born cyborgs: Minds, technologies, and the future of human intelligence*. Oxford: Oxford University Press.

Collini, S. (2012). *What are universities for?* New York, NY: Penguin Press.

Collins, H. M. (1985). *Changing order: Replication and induction in scientific practice*. London: Sage Publications.

Collins, H. M. (1999). Tantalus and the aliens: Publications, audiences and the search for

gravitational waves. *Social Studies of Science*, *29*(2), 163-197.

Collins, H. M., & Pinch, T. J. (1993). *The golem*. Cambridge: Cambridge University Press.

Condit, C. (1996). How bad science stays that way: Brain sex, demarcation, and the status of truth in the Rhetoric of Science. *Rhetoric Society Quarterly*, *26*(4), 83-109.

Connell, I., & Galasinski, D. (1998). Academic mission statements: An exercise in negotiation. *Discourse & Society*, *9*(4), 457-479.

Cooren, F. (2006). From agency to structure: Analysis of an episode in a facilitation process. *Human Relations*, *59*(4), 533-565.

Corballis, M. C. (2010). Mirror neurons and the evolution of language. *Brain and Language*, *112*(1).

Craighero, L., Bello, A., Fadiga, L., & Rizzolatti, G. (2002). Hand action preparation influences the processing of hand pictures. *Neuropsychologia*, *40*, 492-502.

Damasio, A. R. (1999). *The feeling of what happens: Body and emotion in the making of consciousness*. New York, NY: Harcourt Brace.

Damasio, A. R. (2003). *Looking for Spinoza: Joy, sorrow, and the feeling brain*. Orlando, FL: Harcourt.

Dapretto, M., Davies, M., Pfeifer, J. H., Scott, A. A., Sigman, M., Bookheimer, S. Y., & Iacoboni, M. (2006). Understanding emotions in others: Mirror neuron disfunction in children with Autism Spectrum Disorders. *Nature Neuroscience*, *9*(1), 28-30.

Davis, D. (2008). Identification: Burke and Freud on who you are. *Rhetoric Society Quarterly*, *38*(2), 123-147.

Davis, D. (2010). *Inessential solidarity: Rhetoric and foreigner relations*. Pittsburgh, PA:

University of Pittsburgh Press.

De Vignemont, F. (2004). The co-consciousness hypothesis. *Phenomenology and the Cognitive Sciences*, *3*(1), 97-114.

Deacon, T. W. (1997). *The symbolic species: The co-evolution of language and the brain*. New York, NY: W.W. Norton.

Decety, J. (2010). To what extent is the experience of empathy mediated by shared neural circuits? *Emotion Review*, *2*(3), 204-207.

Decety, J., & Jeannerod, M. (1995). Mentally simulated movements in virtual reality: Does Fitt's Law hold in motor imagery? *Behavioural Brain Research*, *72*(1-2), 127-134.

Decety, J., Grezes, J., Costes, N., Perani, D., Jeannerod, M., Procyk, E., ... Fazio, F. (1997). Brain activity during observation of action: Influence of action content and subject's strategy. *Brain*, *120*, 1763-1777.

Delange, F., Spronk, M., Willems, R., Toni, I., & Bekkering, H. (2008). Complementary systems for understanding action intentions. *Current Biology*, *18*(6), 454-457.

Deleuze, G., & Guattari, F. (1994). *What is philosophy?* (H. Tomlinson & G. Burchell, Trans.). New York, NY: Columbia University Press.

Derrida, J. (1978). *Writing and difference*. Chicago, IL: University of Chicago Press.

Dickenson, G. (2002). Joe's Rhetoric: Starbucks and the spatial rhetoric of authenticity. *Rhetoric Society Quarterly*, *32*, 5-28.

Donald, M. (1991). *Origins of the modern mind: Three stages in the evolution of culture and cognition*. Cambridge, MA: Harvard University Press.

Doorewaard, H., & Van Bijsterveld, M. (2001). The osmosis of ideas: An analysis of the

integrated approach to IT management from a Translation Theory perspective. *Organization*, *8*(1), 55-76.

Dumit, J. (1999). Objective brains, prejudicial images. *Science in Context*, *12*(01), 173.

Dumit, J. (2004). *Picturing personhood: Brain scans and biomedical identity*. Princeton, NJ: Princeton University Press.

Eades, T. (1996). Plato, rhetoric, and silence. *Philosophy & Rhetoric*, *29*(3), 244-258.

Emig, J. (1977). Writing as a mode of learning. *College Composition and Communication*, *28*(2), 122-128.

Enticott, P. G., Johnston, P. J., Herring, S. E., Hoy, K. E., & Fitzgerald, P. B. (2008). Mirror neuron activation is associated with facial emotion processing. *Neuropsychologia*, *46*(11), 2851-2854.

Faber, B. (2007). *Discourse, technology and change.* London: Continuum.

Fadiga, L., Fogassi, L., & Gallese, V. (2002). From mirror neurons to imitation: From facts to speculation. In G. Rizzolatti (Author), *The imitative mind: Development, evolution, and brain bases* (pp. 247-266). Cambridge: Cambridge University Press.

Fahnestock, J. (2005). Rhetoric in the age of Cognitive Science. In R. Graff (Ed.), *The Viability of Rhetoric* (pp. 159-179). New York, NY: State University of New York Press.

Fahnestock, J. (2005). Rhetoric of Science: Enriching the discipline. *Technical Communication Quarterly*, *14*(3), 277-286.

Fairclough, N. (2003). *Analyzing discourse: Textual analysis for social research*. New York, NY: Routledge.

Farsin, H., Rijntjes, M., Dettmers, C., Glauche, V., Weiller, C., & Büchel, C. (2003). The Human Action Recognition System and its relationship to Broca's Area: An fMRI study. *Neuroimage*, *19*, 637-644.

Filimon, F., Nelson, J. D., Hagler, D. J., & Sereno, M. I. (2007). Human cortical representations for reaching: Mirror neurons for execution, observation, and imagery. *NeuroImage*, *37*(4), 1315-1328.

Flower, L., & Hayes, J. R. (1981). A Cognitive Process Theory of Writing. *College Composition and Communication*, *32*(4), 365-387.

Fogassi, L., Gallese, V., Fadiga, L., Luppino, G., Matelli, M., & Rizzolatti, G. (1996). Coding of peripersonal space in inferior premotor cortex. *Journal of Neurophysiology*, *76*, 141-157.

Foucault, M. (1972/2010). *Archeology of knowledge*. London: Routledge.

Foulkes, S. (1971). Access to unconscious processes in the Group Analytic Group. *Group Analysis*, *4*(1), 4-14.

Foulkes, S. H. (1964). *Therapeutic group analysis*. London: Allen and Unwin.

Freadman, A. (2002). Uptake. In R. Coe, L. Lingard, & T. Teslenko (Eds.), *The rhetoric and ideology of genre: Strategies for stability and change* (pp. 39-53). Creskill, NJ: Hampton Press.

Frodeman, R., & Mitcham, C. (2007). New directions in interdisciplinarity: Broad, deep, and critical. *Bulletin of Science, Technology & Society*, *27*(6), 506-514.

Gallese, V. (2003). The roots of empathy: The shared manifold hypothesis and the neural basis of intersubjectivity. *Psychopathology*, *36*(4), 171-180.

Gallese, V. (2006). Mirror neurons and intentional attunement: Commentary on olds. *Journal of American Psychoanalytic Association*, *54*, 47-57.

Gallese, V. (2007). Before and below 'theory of mind': Embodied simulation and the neural correlates of social cognition. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *362*(1480), 659-669.

Gallese, V., & Fogassi, L. (2002). The neural correlates of action-understanding in non-human primates. In V. Gallese & M. Stamenov (Eds.), *Mirror neurons and the evolution of brain in language* (pp. 13-36). Philadelphia, PA: John Benjamins Publishing.

Gallese, V., & Goldman, A. (1998). Mirror neurons and the simulation theory of mind-reading. *Trends in Cognitive Sciences*, *12*(2), 493-501.

Gallese, V., & Keysers, C. (2001). Mirror neurons: A sensorimotor representation system. *Behavioral and Brain Sciences*, *24*(5), 983-984.

Gallese, V., Keysers, C., & Rizzolatti, G. (2004). A unifying view of the basis of social cognition. *Trends in Cognitive Sciences*, *8*(9), 396-403.

Gee, J. P. (2005). *An introduction to discourse analysis: Theory and method*. New York, NY: Routledge.

Geisler, C. (2004). *Analyzing streams of language: Twelve steps to the systematic coding of text, talk, and other verbal data*. New York: Pearson/Longman.

Gibbons, M. (2007). Seeing the mind in the matter: Functional brain imaging as framed visual argument. *Argumentation and Advocacy*, *43*, 175-188.

Gitlin, T. (1980). *The whole world is watching: Mass media in the making and unmaking of*

the New Left. Berkeley, CA: University of California Press.

Goffman, E. (1974). *Frame analysis: An essay on the organization of experience*. New York: Harper & Row.

Goldman, A. I. (2006). *Simulating minds: The philosophy, psychology, and neuroscience of mindreading*. Oxford: Oxford University Press.

Goldman, A. I. (2008). Hurley on simulation. *Philosophy and Phenomenological Research*, *77*(3), 775-788.

Graham, S. S. (2009). Agency and the Rhetoric of Medicine: Biomedical brain scans and the ontology of Fibromyalgia. *Technical Communication Quarterly*, *18*(4), 376-404.

Graham, S. S., & Herndl, C. G. (forthcoming, 2012). Multiple ontologies and the rhetoric of pain: Towards a post-plural rhetoric of science. *Technical Communication Quarterly*.

Gregg, M., & Seigworth, G. J. (2010). *The affect theory reader*. Durham, NC: Duke University Press.

Grezes, J., Armony, J., Rowe, J., & Passingham, R. (2003). Activations related to 'Mirror' and 'Canonical' Neurons in the human brain: An fMRI Study. *Neuroimage*, *18*, 928-937.

Gross, A. G., & Keith, W. M. (1997). *Rhetorical hermeneutics: Invention and interpretation in the age of science*. Albany: State University of New York Press.

Gross, A. G., Harmon, J. E., & Reidy, M. S. (2002). *Communicating science: The scientific article from the 17th century to the present*. Oxford: Oxford University Press.

Gross, D. M. (2006). *The secret history of emotion: From Aristotle's rhetoric to modern brain science*. Chicago, IL: University of Chicago Press.

Gruber, D. (2010). Hey, mind reading just happens - be afraid and happy. *Critical Neuroscience*. Retrieved December, 2010, from http://www.criticalneuroscience.org/blog/

Gruber, D., Jack, J., Kernanen, L., McKenzie, J. M., & Morris, M. B. (2001). Neuroscience and Rhetoric: Engagement and exploration. *POROI*, *7*(1), 1-12.

Gruber, O. (2002). The co-evolution of language and working memory capacity in the human brain. In M. Stamenov & V. Gallese (Eds.), *Mirror Neurons and the Evolution of Brain and Language* (pp. 77-86). Amsterdam: John Benjamins Pub.

Gunn, J. (2006). Review essay: Mourning Humanism, or, the idiom of haunting. *Quarterly Journal of Speech*, *92*(1), 77-102.

Hamzei, F., Rijntjes, M., Dettmers, C., Glauche, V., Weiller, C., & Buchel, C. (2003). The human action recognition system and its relationship to Broca's area: An fMRI study. *Neuroimage*, *19*, 637-644.

Hansen, M. B. (2006). *Bodies in code: Interfaces with digital media*. New York, NY: Routledge.

Hart, S. (2008). *Brain, attachment, and personality: An introduction to neuro-affect development* (D. Silver, Trans.). New York, NY: Karnac Books.

Hawhee, D. (2009). *Moving bodies: Kenneth Burke at the edges of language*. Columbia, SC: University of South Carolina Press.

Hayles, N. (1999). *How we became posthuman: Virtual bodies in cybernetics, literature, and informatics*. Chicago, IL: University of Chicago Press.

Hayles, N. (2005). *My mother was a computer: Digital subjects and literary texts*. Chicago,

IL.: University of Chicago Press.

Hecht-Nielsen, R., & McKenna, T. (2003). *Computational models for neuroscience: Human cortical information processing*. London: Springer.

Heidegger, M. (1977). *The question concerning technology and other essays*. New York, NY: Garland.

Heyes, C. (2010). Mesmerizing Mirror Neurons. *Neuroimage*, *51*, 789-791.

Hickok, G. (2009). Eight problems for the Mirror Neuron Theory of Action Understanding in monkeys and humans. *Journal of Cognitive Neuroscience*, *21*(7), 1229-1243.

Homan, K. (2010). Embodied concepts of Neurobiology in Dance/Movement Therapy practice. *American Journal of Dance Therapy*, *32*, 80-99.

Huettel, S. A., Song, A. W., & McCarthy, G. (2004). *Functional magnetic resonance imaging*. Sunderland, MA: Sinauer Associates.

Iacoboni, M. (2008). *Mirroring people: The new science of how we connect with others*. New York: Farrar, Straus and Giroux.

Iacoboni, M., & Dapretto, M. (2006). The mirror neuron system and the consequences of its dysfunction. *Nature Reviews Neuroscience*, *7*(12), 942-951.

Inamura, T., Toshima, I., Tanie, H., & Nakamura, Y. (2004). Embodied symbol emergence based on Mimesis Theory. *The International Journal of Robotics Research*, *23*(4), 363-377.

Jack, J. (2010). What are Neurorhetorics? *Rhetoric Society Quarterly*, *40*(5), 405-410.

Jack, J., & Appelbaum, L. G. (2010). “This is your brain on rhetoric”: Research directions for Neurorhetorics. *Rhetoric Society Quarterly*, *40*(5), 411-437.

Jacob, P. (2008). What do mirror neurons contribute to human social cognition? *Mind & Language*, *23*(2), 190-223.

Jasinski, J. (2001). *Sourcebook on rhetoric: Key concepts in contemporary rhetorical studies*. Thousand Oaks, CA: Sage Publications.

Jeannerod, M. (1994). The representing brain: Neural correlates of motor intention and imagery. *Behavioral and Brain Sciences*, *17*(02), 187.

Jeannerod, M. (1995). Grasping objects: The cortical mechanisms of visuomotor transformation. *Trends in Neurosciences*, *18*(7), 314-320.

Jellema, T., & Perrett, D. I. (2003). Perceptual history influences neural responses to face and body postures. *Journal of Cognitive Neuroscience*, *15*(7), 961-971.

Jellema, T., Baker, C., Wicker, B., & Perrett, D. (2000). Neural representation for the perception of the intentionality of actions. *Brain and Cognition*, *44*(2), 280-302.

Johnson, J., & Littlefield, M. (2011). Lost and found in translation: Popular neuroscience in the emerging neurodisciplines. In M. Pickersgill & I. Van Keulen (Eds.), *Advances in Medical Sociology* (pp. 279-297). Emerald Group Publishing Limited.

Johnson, N. R. (2009). Technical documents as rhetorical agency. *Archival Science*, *8*(3), 199-215.

Johnson Thornton, D. J. (2011). *Brain culture: Neuroscience and popular media*. New Brunswick, NJ: Rutgers University Press.

Joyce, K. (2005). Appealing images: Magnetic resonance imaging and the production of authoritative knowledge. *Social Studies of Science*, *35*(3), 437-462.

Kelly-Holmes, H. (1998). The discourse of western marketing professionals in Central and

Eastern Europe: Their role in the creation of a context for marketing and advertising messages. *Discourse & Society*, *9*(3), 339-362.

Keränen, L. (2010). *Scientific characters: Rhetoric, politics, and trust in breast cancer research*. Tuscaloosa: University of Alabama Press.

Keysers, C., & Gazzola, V. (2010). Social Neuroscience: Mirror neurons recorded in humans. *Current Biology (Dispatches)*, *20*(8), 353-354.

Knorr-Cetina, K. (1981). *The manufacture of knowledge: An essay on the constructivist and contextual nature of science*. Oxford: Pergamon Press.

Knorr-Cetina, K. (1999). *Epistemic cultures: How the sciences make knowledge*. Cambridge, MA: Harvard University Press.

Kohler, E., Keysers, C., Umilta, M., Fogassi, L., Gallese, V., & Rizzolatti, G. (2002). Hearing sounds, understanding actions: Action representation in mirror neurons. *Science*, *297*(5582), 846-848.

Kohut, H. (1984). *How Does Analysis Cure?* London: University of Chicago Press.

Krolak-Salmon, P., Henaff, M., Isnard, J., Tallon-Baudry, C., Guenot, M., Vighetto, A., ... Mauguiere, F. (2003). An attention modulated response to disgust in human ventral anterior insula. *Annals of Neurology*, *53*(4), 446-453.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago, IL: University of Chicago Press.

Lanham, R. A. (1993). *The electronic word: Democracy, technology, and the arts*. Chicago, IL: University of Chicago Press.

Latour, B. (1987). *Science in action: How to follow scientists and engineers through society*.

Cambridge, MA: Harvard University Press.

Latour, B. (1997). A well-articulated primatology - Reflexions of a fellow traveler. In L. Fedigan & S. Strum (Eds.), *Primate Encounters* (pp. 358-381). Chicago, IL: University of Chicago Press.

Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory*. Oxford: Oxford University Press.

Latour, B., & Woolgar, S. (1979). *Laboratory life: The social construction of scientific facts*. Beverly Hills, CA: Sage Publications.

Law, J. (1992). Notes on the theory of the actor-network: Ordering, strategy, and heterogeneity. *Systems Practice*, *5*(4), 379-393.

Law, J. (1999). Traduction/Trahison: Notes on ANT. *Centre for Science Studies, Lancaster University*. Retrieved February, 2012, from www.lancs.ac.uk/fass/sociology/papers/law-traduction-trahison.pdf

Lazarus, R. S. (1982). Thoughts on the relations between emotion and cognition. *American Psychologist*, *37*(9), 1019-1024.

LeDoux, J. E. (1998). *The emotional brain: The mysterious underpinnings of emotional life*. New York, NY: Simon & Schuster.

LeFevre, K. B. (1987). *Invention as a social act*. Carbondale, IL: Southern Illinois University Press.

Licona, A. (2007). Shifting agency: Agency, kairos, and the possibilities of social action. In C. Herndl (Author), *Communicative practices in workplaces and the professions: Cultural perspectives on the regulation of discourse and organizations* (pp. 133-154).

Amityville, NY: Baywood Pub.

Lieberman, M. D. (2006). Social Cognitive and Affective Neuroscience: When opposites attract. *Social Cognitive and Affective Neuroscience*, *1*(1), 1-2.

Lingnau, A., Gesierich, B., & Caramazza, A. (2009). Assymetric fMRI adaptation reveals no evidence for mirror neurons in humans. *Proceedings of the National Academy of Sciences*, *106*(24), 9925-9930.

Lohmar, D. (2006). Mirror neurons and the phenomenology of intersubjectivity. *Phenomenology and the Cognitive Sciences*, *5*(1), 5-16.

Lowe, A. (2000). The construction of a network at Health Waikato – The "towards clinical budgeting" project. *Journal of Management in Medicine*, *14*(3/4), 210-239.

Lynch, J. (2009). Articulating scientific practice: Understanding Dean Hamer's ''Gay Gene. *Quarterly Journal of Speech*, *95*(4), 435-465.

Lyons, D. E., Santos, L. R., & Keil, F. C. (2006). Reflections of other minds: How primate social cognition can inform the function of mirror neurons. *Current Opinion in Neurobiology*, *16*(2), 230-234.

MacKenzie, D. (1978). Statistical theory and social interests: A Case-Study. *Social Studies of Science*, *8*(1), 35-83.

Marcum, J. (2008). Instituting Science: Discovery or construction of scientific knowledge? *International Studies in the Philosophy of Science*, *22*(2), 185-210.

Massumi, B. (2002). *Parables for the virtual: Movement, affect, sensation*. Durham, NC: Duke University Press.

McGlone, F., Howard, M., & Roberts, N. (2002). Brain activation to passive observation of

grasping actions. In V. Gallese & M. Stamenov (Eds.), *Mirror neurons and the evolution of brain and language* (pp. 125-135). Philadelphia, PA: John Benjamins Pub.

McKenna, T. (2003). Preface. In R. Hecht-Nielsen (Author), *Computational Models for Neuroscience* (pp. V-Ix). London: Springer.

McKeon, R. (1994). The uses of rhetoric in a technological age: Architectonic productive arts. In T. Enos & S. C. Brown (Eds.), *Professing the New Rhetoric* (pp. 126-144). Newark, NJ: Prentice Hall.

Meekums, B. (2010). Moving towards evidence for Dance Movement Therapy: Robin Hood in dialogue with the King. *The Arts in Psychotherapy*, *37*, 35-41.

Merleau-Ponty, M. (1958). *Phenomenology of perception.* New York: Routledge.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco, CA: Jossey-Bass.

Metta, G., Sandini, G., Natale, L., Craighero, L., & Fadiga, L. (2006). Understanding mirror neurons: A bio-robotic approach. *Interaction Studies*, *7*(2), 197-232. doi: 10.1075/is.7.2.06met

Metzinger, T. (2009). *The ego tunnel: The science of the mind and the myth of the self*. New York, NY: Basic Books.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Thousand Oaks, CA: Sage Publications.

Miller, C. (1979). A humanistic rational for technical writing. *College English*, *40*(6), 610-617.

Miller, C. (1992). Kairos in the Rhetoric of Science. In S. P. White, N. Nakadate, & R. D. Cherry (Eds.), *A Rhetoric of Doing: Essays Written in the Honor of James L. Kinneavy* (pp. 310-337). Carbondale, IL: University of Illinois Press.

Miller, C. (2007). What can automation tell us about agency? *Rhetoric Society Quarterly*, *37*(2), 137-157.

Miller, C. (Writer). (2007, November). *The art of concealment: Rhetoric in scientific and technical discourse*. Live performance in Norwegian Academy of Science and Letters, 150th Anniversary, Oslo.

Misa, T. (1992). Controversy & closure in technological change: Constructing steel. In *Shaping Technology/Building Society: Studies in Sociotechnical Change*. Cambridge, MA: MIT Press.

Mol, A. (2002). *The body multiple: Ontology in medical practice*. Durham, NC: Duke University Press.

Mol, A., & Law, J. (1994). Regions, networks and fluids: Anaemia and social topology. *Social Studies of Science*, *24*(4), 641-671.

Muckelbauer, J. (2007). Rhetoric, asignification, and the Other: A response to Diane Davis. *Philosophy and Rhetoric*, *40*(2), 238-247.

Mukamel, R., Ekstrom, A. D., Kaplan, J., Iacoboni, M., & Fried, I. (2010). Single-Neuron responses in humans during execution and observation of actions. *Current Biology*, *20*(8), 750-756.

Nava, A. S. (2007). Empathy and Group Analysis: An integrative approach. *Group Analysis*, *40*(1), 13-28.

Nowotny, H. (1980). Science and Daily Life: The ontology of scientific explanations. In H. Maturana (Author) & W. Krohn & G. Küppers (Eds.), *Selforganization: Portrait of a scientific revolution* (pp. 12-35). Dordrecht: Reidel Publishing.

Nunes, T. (2003). The sociocultural construction of implicit knowledge. *Cognitive Development*, *18*(4), 451-454.

Nussbaum, M. C. (2010). *Not for profit: Why democracy needs the humanities*. Princeton, NJ: Princeton University Press.

Oberman, L. M., Hubbard, E. M., McCleery, J. P., Altschuler, E. L., Ramachandran, V. S., & Pineda, J. A. (2005). EEG Evidence for mirror neuron dysfunction in Autism Specturm Disorders. *Cognitive Brain Research*, *24*(2), 190-198.

O'Loughlin, M. (2006). *Embodiment and Education: Exploring creatural existence*. New York, NY: Springer.

Papoulias, C., & Callard, F. (2010). Biology's Gift: Interrogating the turn to affect. *Body & Society*, *16*(1), 29-56.

Pellegrino, G., Fadiga, L., Fogassi, L., Gallese, V., & Rizzolatti, G. (1992). Understanding motor events: A neurophysiological study. *Experimental Brain Research*, *91*(1).

Pera, M. (1994). *The discourses of science*. Chicago, IL: University of Chicago Press.

Perelman, C., & Olbrechts-Tyteca, L. (1958). De la temporalité comme caractère de l'argumentation. *Archivio Di Fi Losofi a*, *28*(2), 115-133.

Pines, M. (2003). Social brain and social group: How mirroring connects people. *Group Analysis*, *36*(4), 507-513.

Pisani, R. A. (2010). Malcolm Pines' contribution to Group Analysis. *Group Analysis*, *43*(3),

328-336.

Plailly, J., Radnovich, A. J., Sabri, M., Royet, J., & Kareken, D. A. (2007). Involvement of the left anterior insula and frontopolar gyrus in odor discrimination. *Human Brain Mapping*, *28*(5), 363-372.

Porges, S. (2009). Reciprocal influences between body and brain in the perception and expression of affect: A polyvagal perspective. In D. Fosha, D. Seigel, & M. Solomon (Eds.), *The healing power of emotion: Affective neuroscience, development, and clinical practice* (pp. 27-54). New York, NY: W.W. Norton.

Poulakos, J. (1983). Toward a sophistic definition of rhetoric. *Philosophy & Rhetoric*, *16*(1), 35-48.

Preester, H. (2008). From ego to alter ego: Husserl, Merleau-Ponty and a layered approach to intersubjectivity. *Phenomenology and the Cognitive Sciences*, *7*(1), 133-142.

Prelli, L. J. (1989). *A rhetoric of science: Inventing scientific discourse*. Columbia, SC: University of South Carolina Press.

Press, C., Cook, J., Blakemore, S., & Kilner, J. (2011). Dynamic modulation of human motor activity when observing actions. *Journal of Neuroscience*, *31*(8), 2792-2800.

QuickSearch. (n.d.). *NCSU Libraries*. Retrieved March, 2012, from http://www.lib.ncsu.edu/dli/projects/quicksearch/

Racine, E., Bar-Ilan, O., & Illes, J. (2005). Science and Society: FMRI in the public eye. *Nature Reviews Neuroscience*, *6*(2), 159-164.

Raichle, M. E. (2009). A brief history of human brain mapping. *Trends in Neurosciences*, *32*(2), 118-126.

Ramachandran, V. S. (2008). Reflecting on the mind. *Nature*, *452*(7189), 814-815.

Raos, V., Umilta, M., Gallese, V., & Fogassi, L. (2004). Functional properties of grasping-related neurons in the Dorsal Premotor Area F2 of the macaque monkey. *Journal of Neurophysiology*, *92*(4), 1990-2002.

Restak, R. M. (2006). *The naked brain: How the emerging neurosociety is changing how we live, work, and love*. New York: Harmony Books.

Rice, J. E. (2008). The New "New": Making a case for Critical Affect Studies. *Quarterly Journal of Speech*, *94*(2), 200-212. doi: 10.1080/00335630801975434

Rizzolatti, G., & Sinigaglia, C. (2008). Further reflections on how we interpret the actions of others. *Nature*, *455*(7213), 589-589. doi: 10.1038/455589b

Rizzolatti, G., & Sinigaglia, C. (2010). The functional role of the parieto-frontal mirror circuit: Interpretations and misinterpretations. *Nature Reviews Neuroscience*, *11*(4), 264-274.

Rizzolatti, G., Fadiga, L., Matelli, M., Bettinardi, V., Paulesu, E., Perani, D., & Fazio, F. (1996). Localization of grasp representations in humans by PET: 1. Observation versus execution. *Experimental Brain Research*, *111*(2).

Rizzolatti, G., Fogassi, L., & Gallese, V. (2001). Opinion: Neurophysiological mechanisms underlying the understanding and imitation of action. *Nature Reviews Neuroscience*, *2*, 661-670.

Robinson, J. (2005). *Deeper than reason: Emotion and its role in literature, music, and art*. Oxford: Clarendon Press.

Schermer, V. L. (2010). Reflections on 'Reflections on Mirroring' *Group Analysis*, *43*(3),

214-227.

Schilhab, T. (2007). Interactional expertise through the looking glass: A peek at mirror neurons. *Studies In History and Philosophy of Science Part A*, *38*(4), 741-747.

Schoenberger, E. (2001). Interdisciplinarity and social power. *Progress in Human Geography*, *25*(3), 365-382.

Scott, R. L. (1967). On viewing rhetoric as epistemic. *Central States Speech Journal*, *18*(1), 9-17.

Segal, J. Z. (2005). Interdisciplinarity and bibliography in Rhetoric of Health and Medicine. *Technical Communication Quarterly*, *14*(3), 311-318.

Selzer, J. (1999). Habeas Corpus: An introduction. In S. Crowley & J. Selzer (Eds.), *Rhetorical Bodies* (pp. 3-15). Madison, WI: University of Wisconsin Press.

Shapiro, L. (2009). Making sense of mirror neurons. *Synthese*, *167*(3), 439-456.

Shaviro, S. (1990). *Passion & excess: Blanchot, Bataille, and literary theory*. Tallahassee, FL: Florida State University Press.

Shmuelof, L. (2006). A mirror representation of others' actions in the Human Anterior Parietal Cortex. *Journal of Neuroscience*, *26*(38), 9736-9742.

Skærbæk, P., & Melander, P. (2004). The politics of the changing forms of accounting: A field study of strategy translation in a Danish government-owned company under privatisation. *Accounting, Auditing & Accountability Journal*, *17*(1), 17-40.

Slaby, J. (2010). Steps towards a Critical Neuroscience. *Phenomenology and the Cognitive Sciences*, *9*(3), 397-416.

Slors, M., & Macdonald, C. (2008). Rethinking folk-psychology: Alternatives to theories of

mind. *Philosophical Explorations*, *11*(3), 153-161.

Smith, C. R., & Lybarger, S. (1996). Bitzer's model reconstructed. *Communication Quarterly*, *44*(2), 197-213.

Smith, S., Rose, M., & Hamilton, E. (2010). The story of a university knowledge exchange actor-network told through the sociology of translation: A case study. *International Journal of Entrepreneurial Behaviour & Research*, *16*(6), 502-516.

Solomon, R. (1988). On emotions as judgments. *American Philosophical Quarterly*, *25*, 183-191.

Stamenov, M., & Gallese, V. (2002). *Mirror neurons and the evolution of brain and language*. Amsterdam: John Benjamins Pub.

Star, S. L., & Griesemer, J. R. (1989). Institutional Ecology, `Translations' and Boundary Objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. *Social Studies of Science*, *19*(3), 387-420.

Stern, D. N. (1985). *The interpersonal world of the infant: A view from psychoanalysis and developmental psychology*. New York, NY: Basic Books.

Suchman, L. (2005). Affiliative Objects. *Organization*, *12*(3), 379-399.

Tessitore, G., Prevete, R., Catanzariti, E., & Tamburrini, G. (2010). From motor to sensory processing in mirror neuron computational modeling. *Biological Cybernetics*, *103*(6), 471-485.

Thomson, H. (2010). Mirror neurons recorded in humans at last. *The New Scientist*, *206*(2756), 12-12.

Toulmin, S., Rieke, R. D., & Janik, A. (1984). *An introduction to reasoning* (2nd ed.). New

York, NY: Macmillan.

Turella, L., Pierno, A., Tubaldi, F., & Castiello, U. (2009). Mirror neurons in humans: Consisting or confounding evidence? *Brain and Language*, *108*(1), 10-21.

Umiltà, M., Gallese, V., Fogassi, L., Fadiga, L., Keysers, C., & Rizzolatti, G. (2001). 'I know what you are doing': A Neurophsyiological Study. *Neuron*, *32*, 91-101.

Van Horn, J. (2004). Cognitive neuroimaging: History, developments, and directions. In M. Gazzaniga (Ed.), *The Cognitive Neurosciences* (3rd ed., pp. 1281-1293). Cambridge, MA: Cambridge University Press.

Van Dijk, T. A. (1995). Interdisciplinarity. *Discourse & Society*, *6*(4), 459-460.

Verhoeven, L., Schnotz, W., & Paas, F. (2009). Cognitive load in interactive knowledge construction. *Learning and Instruction*, *19*(5), 369-375.

Wander, P. (1999). The third persona: An ideological turn in rhetorical theory. In J. Louis Lucaites, C. M. Condit, & S. Caudill (Eds.), *Contemporary Rhetorical Theory: A Reader* (pp. 357-379). New York, NY: The Guilford Press.

Weisberg, D. S., Keil, F. C., Goodstein, J., Rawson, E., & Gray, J. R. (2008). The seductive allure of neuroscience explanations. *Journal of Cognitive Neuroscience*, *20*(3), 470-477.

Welberg, L. (2008). Mirror neurons: Towards a clearer image. *Nature Reviews Neuroscience*, *9*(12), 888-889.

Wicker, B., Keysers, C., Plailly, J., Royet, J., Gallese, V., & Rizzolatti, G. (2003). Both of us disgusted in my Insula: The common neural basis of seeing and feeling disgust. *Neuron*, *40*(3), 655-664.

Winters, A. F. (2008). Emotion, embodiment, and mirror neurons in Dance/Movement Therapy: A connection across disciplines. *American Journal of Dance Therapy*, *30*(2), 84-105.

Wohlschlager, A., & Bekkering, H. (2002). The role of objects in imitation. In V. Gallese & M. Stamenov (Eds.), *Mirror neurons and the evolution of brain and language* (pp. 101-115). Philadelphia, PA: John Benjamins Pub.

Wolf, N. S., Gales, M. E., Shane, E., & Shane, M. (2001). The developmental trajectory from amodal perception to empathy and communication: The role of mirror neurons in this process. *Psychoanalytic Inquiry*, *21*(1), 94-112.

Yalom, I. D. (2005). *The theory and practice of group psychotherapy*. New York, NY: Basic Books.

APPENDICES

Appendix A: Two-Phase Text Sampling: Disciplines and Conversations

Phase One: 164 Journal Articles Coded Across 10 Disciplinary Categories

Biology	70
Psychology / Psychiatry	29
Philosophy	20
Biology	19
Interaction Studies / Group Studies	9
Engineering Robotics	6
The Arts	6
Specialty Journals Covering Specific Disease Diagnosis	4
Childhood Education	1

Phase Two: 164 Journal Articles Coded (non-exclusively) Across 14

Conversations

Multiple Neuroscientific explorations of mirror neurons not covered by other categories	32	Red = Scientific debates about the nature or function of mirror neurons.
The role of mirror neurons in speech or sound	27	
The role of mirror neurons in various discussions of emotions	22	
Basic neuroscientific debates about the empirical nature of mirror neurons	19	
Debates about "Action Understanding" from mirror neurons	18	
Social-Scientific or Humanistic discussions not covered by other categories	13	Orange = Multiple disciplines discussing a range of topics from mirror neuron research

Discussions of Autism exclusively	12	Yellow = Multiple disciplines discussing a specialty topic from mirror neuron research
Phenomenology: problem of other minds (related *sub-sampled articles in terms of issues of intersubjectivity)	14 (*7)	Green = Definable disciplinary viewpoint discussing a field-specific concern from mirror neuron research
Imitation in Robotic Engineering	10	
Movement Therapy in the Arts	7	
Social or Psychological Analysis (related *sub-sampled articles in terms of Group Analysis only)	12 (*3)	
Philosophical discussions not covered by other categories	5	
Discussions of Schizophrenia exclusively	2	

Issues in Psychology not covered by other categories	1	